By Steven L. Gortmaker, Y. Claire Wang, Michael W. Long, Catherine M. Giles, Zachary J. Ward, Jessica L. Barrett, Erica L. Kenney, Kendrin R. Sonneville, Amna Sadaf Afzal, Stephen C. Resch, and Angie L. Cradock

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Three Interventions That Reduce Childhood Obesity Are Projected To Save More Than They Cost To Implement

Steven L. Gortmaker (sgortmak@hsph.harvard.edu) is a professor of the practice of health sociology at the Harvard T.H. Chan School of Public Health, in Boston, Massachusetts.

Y. Claire Wang is an associate professor at the Mailman School of Public Health, Columbia University, in New York City.

Michael W. Long is an assistant professor at the Milken Institute School of Public Health, the George Washington University, in Washington, DC.

Catherine M. Giles is a program manager at the Harvard T.H. Chan School of Public Health.

Zachary J. Ward is a programmer analyst at the Harvard T.H. Chan School of Public Health.

Jessica L. Barrett is a research assistant IV at the Harvard T.H. Chan School of Public Health.

Erica L. Kenney is a postdoctoral research fellow at the Harvard T.H. Chan School of Public Health.

Kendrin R. Sonneville is an assistant professor at the University of Michigan School of Public Health, in Ann Arbor.

Amna Sadaf Afzal is an assistant professor at the Albert Einstein College of Medicine, in New York City.

ABSTRACT Policy makers seeking to reduce childhood obesity must prioritize investment in treatment and primary prevention. We estimated the cost-effectiveness of seven interventions high on the obesity policy agenda: a sugar-sweetened beverage excise tax; elimination of the tax subsidy for advertising unhealthy food to children; restaurant menu calorie labeling; nutrition standards for school meals; nutrition standards for all other food and beverages sold in schools; improved early care and education; and increased access to adolescent bariatric surgery. We used systematic reviews and a microsimulation model of national implementation of the interventions over the period 2015–25 to estimate their impact on obesity prevalence and their cost-effectiveness for reducing the body mass index of individuals. In our model, three of the seven interventions—excise tax, elimination of the tax deduction, and nutrition standards for food and beverages sold in schools outside of meals—saved more in health care costs than they cost to implement. Each of the three interventions prevented 129,000–576,000 cases of childhood obesity in 2025. Adolescent bariatric surgery had a negligible impact on obesity prevalence. Our results highlight the importance of primary prevention for policy makers aiming to reduce childhood obesity.

The childhood obesity epidemic in the United States affects all segments of society. There is a clear need for action by governments, foundations, and other relevant institutions to address this public health problem. Controlling childhood obesity is complex because many risk behaviors are involved, shaped by multiple environments and requiring multiple intervention strategies.[1–4] However, simply asking what works without considering costs has led to the proliferation of obesity treatment and prevention initiatives with limited evaluative information. Little serious discussion has taken place about relative costs or cost-effectiveness. When we searched the PubMed database of the National Library of Medicine for articles published through 2014 containing the term *child obesity*, we found more than 31,000, but only 89 of these also contained the term *cost-effectiveness*. Communities and health agencies have limited resources to address high rates of childhood obesity and need to know how best to invest those resources.

There are two main approaches to altering the population prevalence of obesity in children: treating obesity after onset and preventing excess weight gain (primary prevention). Many studies have documented the effectiveness of interventions using these two different approaches. For example, a meta-analysis of adolescent bariatric surgery studies indicates an average reduction in body mass index (BMI) of 13.5 kg/m^2 following this procedure.[5] Some nonsurgical interventions to treat childhood obesity are effective, but effect sizes are small relative to the high BMIs (or BMI z-scores—that is, BMI scores that are standardized for age and sex) of the children before the intervention,[6] and treatments may reach too few children to have a substantial population-level impact. For example, bariatric surgery is used with only about 1,000 adolescents per year.[7]

The promise of primary prevention strategies during childhood has been bolstered by recent findings generated by mathematical models of the physiological development of excess weight in children, adolescents, and adults.[8,9] Modeling indicates that excess weight accumulates slowly, and excess weight gain among young children is due to relatively small changes in energy balance.

For example, among children ages 2–5, average excess weight gain is driven by an excess of about 33 extra kilocalories per day.[10] Changes needed to prevent excess weight gain and prevent obesity are thus quite small in childhood. By adolescence, however, excess weight has accumulated for more than a decade, with an average imbalance of almost 200 extra kcal/day.[8,10] The typical adult with a BMI greater than 35 (about 14 percent of the adult population) consumes 500 kcal/day more than is needed to maintain a healthy body weight.[9] Improving energy balance via improved diet and physical activity early in childhood thus requires much smaller changes than those needed once obesity is established in adolescence and adulthood.

In addition, a large body of experimental evidence indicates that certain behavioral changes can reduce BMI and obesity prevalence in children. For example, as documented in online Appendix A1,[11] there is clear evidence of the effectiveness of reducing the intake of sugar-sweetened beverages on reducing BMI and obesity prevalence.

There is also strong evidence that reducing television viewing and other screen time leads to significant reductions in BMI and obesity prevalence, mainly via dietary changes[12] (also documented in Appendix A2).[11] Despite growing evidence that targeted interventions can improve diet and reduce BMI and obesity prevalence, there is limited evidence concerning the cost-effectiveness of these approaches and the potential US population–level impact of either treatment or preventive interventions.

In this article we present results of an evidence review and microsimulation modeling project concerning the cost-effectiveness and population-level impact of seven interventions identified as potentially important strategies for addressing childhood obesity. We conducted systematic evidence reviews of the interventions' effectiveness and estimated costs and reach under specified implementation scenarios described in Appendices A1, A2, and A4–A8.[11] We developed a microsimulation model to assess key cost-effectiveness metrics of these interventions if they were to be implemented nationally.

Stephen C. Resch is deputy director of the Center for Health Decision Science at the Harvard T.H. Chan School of Public Health.

Angie L. Cradock is a senior research scientist at the Harvard T.H. Chan School of Public Health.

Study Data And Methods

We developed an evidence review process and microsimulation model to evaluate the cost-effectiveness of interventions for childhood obesity. Our modeling framework built on the Australian Assessing Cost-Effectiveness approach[13,14] in obesity[15] and prevention studies.[16] Our microsimulation model used US population, mortality, and health care cost data. We focused on outcomes of cost per BMI unit change over two years following an intervention and ten-year changes in obesity, health care costs, and net costs. We followed recommendations of the US Panel on Cost-Effectiveness in Health and Medicine in reporting our results, including using a 3 percent discount rate.[17]

Our approach has distinct methodological components designed to improve both the strength of evidence and the applicability of results to real-world decision making. We created a stakeholder group of thirty-two US policy makers, researchers, and nutrition and physical activity experts to provide advice concerning the selection of interventions, evaluation of data, analyses, and implementation and equity issues. This group advised us to look broadly for interventions to evaluate across settings and sectors. The clinical subgroup selected adolescent bariatric surgery as an important benchmark clinical intervention to evaluate, since many insurers pay for this treatment.[18]

INTERVENTIONS Our stakeholder group selected for the study seven interventions that are high on the treatment and prevention policy agenda (further details about the interventions are provided in the Appendices).[11] The interventions are as follows: an excise tax of one cent per ounce on sugar-sweetened beverages, applied nationally and administered at the state level; the elimination of the tax deductibility of advertising costs for television ads seen by children and adolescents for nutritionally poor foods and beverages; restaurant menu calorie labeling, modeled on the federal menu regulations to be implemented under the Affordable Care Act; implementation of nutrition standards for federally reimbursable school meals sold through the National School

Lunch and School Breakfast Programs, modeled on US Department of Agriculture (USDA) regulations implemented under the Healthy, Hunger-Free Kids Act of 2010; implementation of nutrition standards for all foods and beverages sold in schools outside of reimbursable school meals, modeled on USDA regulations implemented under the Healthy, Hunger-Free Kids Act; improved early childhood education policies and practices, including the national dissemination of the Nutrition and Physical Activity Self-Assessment for Child Care (NAP SACC) program; and a nationwide fourfold increase in the use of adolescent bariatric surgery.

INTERVENTION SPECIFICATIONS, IMPLEMENTATION SCENARIOS, AND COSTS We specified a national implementation scenario for each of the interventions using the best available data for population eligibility and costs at each level of implementation, from recruitment to outcomes. Costing followed standard guidelines[19,20] (for details of models and costing, see Appendix A3).[11] All costs were calculated in 2014 dollars and adjusted for inflation using the Consumer Price Index for all nonmedical costs and the Medical Care Consumer Price Index for medical costs.

EVIDENCE REVIEWS OF INTERVENTION EFFECTS We estimated the effects of each of the seven interventions using an evidence review process consistent with the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) approach[21] and guidelines from the Cochrane Collaboration.[22] Details of the evidence reviews for the interventions are provided in Appendices A1, A2, and A4–A8.[11]

MICROSIMULATION MODEL We developed a microsimulation model to calculate the costs and effectiveness of the interventions through their impact on BMI changes, obesity prevalence, and obesity-related health care costs over ten years (2015–25). This is a stochastic, discrete-time, individual-level microsimulation model of the US population designed to simulate the experience of the population from 2015 to 2025.

The model used data from the Census Bureau, American Community Survey, Behavioral Risk Factor Surveillance System, National Health and Nutrition Examination Surveys (NHANES), and National Survey of Children's Health. It also used longitudinal data about weight and height from the National Longitudinal Survey of Youth, National Longitudinal Study of Adolescent to Adult Health, Early Childhood Longitudinal Study—Kindergarten, Panel Survey of Income Dynamics, and NHANES I Epidemiologic Followup Study.

We used smoking initiation and cessation rates from the National Health Interview Surveys and mortality rates by smoking status and BMI from the NIH-AARP Diet and Health Study. Details of the data, analyses, and model are provided in Appendix A3, and key model input parameters are listed in Appendix Exhibit A3.1.[11]

The estimated effects of the interventions on health care costs were based on national analyses that indicated excess health care costs associated with obesity among children and adults (see Appendix A3).[11] We assumed that each intervention took time—typically 18–36 months—to decrease the BMI of individuals who received each intervention.[8,9] Estimates of intervention costs included one-time start-up and ongoing costs, as well as enforcement and compliance costs, but did not include costs of passing a policy. The annual costs for each intervention are the average of its discounted total costs.

We used a "modified" societal perspective on costs. This means that we did not include several possible economic impacts of the interventions, such as productivity losses associated with obesity or patient costs for items such as transportation to clinic visits or the value of time spent seeking or receiving medical care. It was reasonable to exclude these economic impacts because they are difficult to estimate systematically and likely to be small within a ten-year period, relative to the intervention and health care costs.

We assumed that effects were sustained over the model's time frame—that is, eight years after two start-up years. For policy changes such as the sugar-sweetened beverage excise tax, the elimination of the tax subsidy for advertising unhealthy food to children, and restaurant menu calorie labeling, sustaining an effect for ten years is reasonable, as the changed policy will continue over that period. For the interventions that set nutrition standards for school meals and other foods and beverages sold in schools, we can assume that most children will be exposed to these for a substantial period of time—for example, from first through twelfth grades. For bariatric surgery, we can also assume that the surgical change will persist over this time period.

Details of key input parameters for the interventions modeled where there is known variation from reviews of the relevant literature, including the parameters' distributions and assumptions, are outlined in Appendices A1, A2, and A4–A8.[11] As explained above, all results are expressed in 2014 US dollars and discounted at 3 percent annually.

We calculated costs per BMI units reduced over two years (2015–17). We estimated health care costs, net costs, and net costs saved per dollar spent over ten years (2015–25), since this is a time frame frequently used in policy calculations. We inflated health care costs to 2014 dollars using the Medical Care Consumer Price Index.

We estimated obesity cases prevented and changes in childhood obesity prevalence in 2025, at the end of the period of analysis.

UNCERTAINTY AND SENSITIVITY ANALYSES We calculated probabilistic sensitivity analyses by simultaneously sampling all parameter values from predetermined distributions. We report 95 percent uncertainty intervals (around point estimates) in Exhibits 1 and 2, taking 2.5 and 97.5 percentile values from simulated data.[23] We calculated uncertainty intervals using Monte Carlo simulations programmed in Java over one thousand iterations of the model for a population of one million simulated individuals scaled to the national population size.

CONSULTATION The stakeholder group assisted us in reviewing additional considerations, including quality of evidence, equity, acceptability, feasibility, sustainability, side effects, and impacts on social and policy norms.

LIMITATIONS The study had several limitations. First, its results were based on a simulation model that incorporated a broad range of data inputs. While we included the best available evidence on population characteristics, likely trajectories of obesity prevalence, and obesity-related health care costs, our ability to forecast precise impacts of all of the modeled interventions was limited by the uncertainty around each of these inputs and by the assumptions required to build the model (see Appendix A3).[11]

In previous publications we used a Markov cohort simulation model to estimate the impact of two of the interventions modeled here, the sugar-sweetened beverage excise tax and the elimination of the tax subsidy for advertising unhealthy food to children.[24–26] The cohort model was limited in its ability to model heterogeneity of individual differences, exposure to the intervention, and trajectories of BMI over the life course, and it could not calculate population estimates for specific years. With the microsimulation model, we were able to estimate the number of cases of obesity prevented. For both of these interventions, the estimated costs per BMI unit reduction were similar under both modeling approaches, and both interventions were cost-saving.

Second, we modeled each of the interventions separately, which limited our ability to estimate their cumulative effects. Future obesity prevention simulation modeling should begin to evaluate the impact of simultaneous implementation of multiple interventions.

EXHIBIT 1

Population Reach And Cost For Seven Childhood Obesity Interventions In The United States, 2015–25

Intervention	Population reach (millions)	Intervention cost: Per year ($ millions)	Intervention cost: Per unit of BMI reduced ($)
Sugar-sweetened beverage excise tax	306.6	47.6	2.49
95% UI	306.3, 307.0	31.0, 63.8	0.62, 10.59
Restaurant menu calorie labeling	306.6	95.5	13.09
95% UI	306.3, 307.0	82.7, 108.5	−122.61, 154.42
Elimination of the tax subsidy for advertising unhealthy food to children	72.3	0.82	0.66
95% UI	71.9, 72.8	0.82, 0.82	0.27, 1.13
Nutrition standards for school meals	28.0	1,112	53
95% UI	27.8, 28.2	1,112, 1,112	−185, 186
Nutrition standards for all other food and beverages sold in schools	45.2	22.3	6.10
95% UI	45.0, 45.4	22.3, 22.3	2.34, 7.72
Improved early care and education policies and practices (NAP SACC)	1.18	76.0	613
95% UI	1.14, 1.23	75.8, 76.4	99, 730
Increased access to adolescent bariatric surgery	0.0049	30.3	1,611
95% UI	0.0025, 0.0077	20.9, 40.2	1,241, 2,337

SOURCE Authors' calculations, based on the microsimulation model described in Appendix A3 (see Note 11 in text). **NOTES** Costs are in 2014 dollars. Cost per body mass index (BMI) unit reduction is an incremental cost-effectiveness ratio. UI is uncertainty interval. NAP SACC is Nutrition and Physical Activity Self-Assessment for Child Care.

EXHIBIT 2

Estimated Ten-Year Cost-Effectiveness And Economic Outcomes For Seven Childhood Obesity Interventions In The United States, 2015–25

Intervention	Net costs ($ millions)	Cases of childhood obesity prevented as of 2025	Health care costs saved per dollar spent ($)
Sugar-sweetened beverage excise tax	−14,169	575,936	30.78
95% UI	−47,119, −2,645	131,794, 1,890,715	6.07, 112.94
Restaurant menu calorie labeling	−4,675	41,015	5.90
95% UI	−16,010, 6,284	−41,324, 122,396	−5.06, 18.00
Elimination of the tax subsidy for advertising unhealthy food to children	−260	129,061	32.53
95% UI	−431, −94	48,200, 212,365	12.42, 53.35
Nutrition standards for school meals	6,436	1,815,966	0.42
95% UI	2,458, 12,560	−547,074, 3,381,312	−0.13, 0.78
Nutrition standards for all other food and beverages sold in schools	−792	344,649	4.56
95% UI	−1,339, −251	163,023, 522,285	2.13, 7.01
Improved early care and education policies and practices (NAP SAAC)	731	38,385	0.04
95% UI	706, 754	8,258, 69,111	0.01, 0.07
Increased access to adolescent bariatric surgery	303	—[a]	—[a]
95% UI	209, 401	—[a]	—[a]

SOURCE Authors' calculations based on the microsimulation model described in Appendix A3 (see Note 11 in text). **NOTES** Costs are in 2014 dollars; negative net costs indicate cost savings. Cost-saving interventions result in at least $1 of health care costs saved per $1 spent on the intervention. UI is uncertainty interval. NAP SACC is Nutrition and Physical Activity Self-Assessment for Child Care. [a]Not applicable.

Third, there is limited evidence that directly links the interventions we evaluated to change in population-level obesity prevalence. However, as detailed in Appendices A1, A2, and A4–A8,[11] six of the interventions were supported by randomized trials or natural or quasi-experimental evaluations[27] that linked the intervention or behavioral mechanism targeted by the intervention directly to reductions in BMI for recipients of each intervention. We incorporated uncertainty for all of the underlying model inputs into the probabilistic uncertainty analyses (see Appendix A3.1).[11]

Fourth, because we focused on obesity, we did not incorporate additional health improvements and health care cost reductions due to improvements in diet and physical activity that were independent of reductions in BMI (for example, reductions in diabetes and heart disease).[28]

Study Results

There were large differences in the projected population reach of the interventions (Exhibit 1). The reach of bariatric surgery, the smallest, was very limited, even assuming a fourfold increase in the number of adolescents who receive the procedure. The most recent national data indicate that in 2012, among adolescents classified as having grade 3 obesity (a BMI of roughly 40 or above), fewer than two in a thousand received the procedure (Appendix A8).[11] The largest population reaches occurred with interventions that would affect the whole population, such as the sugar-sweetened beverage excise tax and restaurant menu calorie labeling—both of which would reach 307 million people.

The annual costs of the interventions were driven by both the cost per person and the population reach and varied greatly (Exhibit 1).

Differences across interventions in cost per BMI unit reduction varied more than 2,000-fold. Eliminating the tax deduction for advertising nutritionally poor food to children would reduce a BMI unit for $0.66 per person, while increasing access to bariatric surgery would reduce a BMI unit for $1,611.

Three of the interventions studied were found to be cost-saving across the range of modeled uncertainty: the sugar-sweetened beverage excise tax, eliminating the tax subsidy for advertising unhealthy food to children, and setting nutrition standards for food and beverages sold in schools outside of school meals (Exhibit 2). In other words, these interventions were projected to save more in reduced health costs over the period studied than the interventions would cost to implement. Perhaps more important, the interventions were projected to prevent 576,000, 129,100, and 345,000 cases of childhood obesity, respectively, in 2025. The net savings to society for each dollar spent were projected to be $30.78, $32.53, and $4.56, respectively.

Restaurant menu calorie labeling was also projected to be cost-saving (Exhibit 2), although on average the uncertainty intervals were wide because of the wide uncertainty interval around the estimated per meal reduction in calories ordered or purchased as a result of the intervention (see Appendix A4).[11] This uncertainty highlights the need for ongoing monitoring of this policy when it is implemented nationwide in 2016. Of note, a study of restaurant menu calorie labeling in King County, Washington, found that eighteen months after implementation of menu calorie labeling regulations, restaurants had reduced their calorie content by 41 kilocalories per entrée,[29] a much larger effect than the reduction of 8 kilocalories per meal estimated in this study.

Setting nutrition standards for school meals would reach a very large population of children and have a substantial impact: An estimated 1,816,000 cases of childhood obesity would be prevented, at a cost of $53 per BMI unit change (Exhibits 1 and 2). Improved early care and education policies and practices would reach a much smaller segment of the population (1.18 million), preventing 38,400 childhood obesity cases if implemented nationally, at a cost of $613 per BMI unit change.

The modeled preventive interventions could significantly reduce the overall prevalence of childhood obesity in the United States. Currently, the prevalence of obesity among children and youth is about 17 percent.[30] Based on our model, the largest reduction in childhood obesity prevalence compared to no intervention would occur with the implementation of nutrition standards for school meals (a reduction of 2.6 percent; data not shown), followed by the sugar-sweetened beverage excise tax (0.8 percent). Adding in the two other cost-saving interventions (elimination of the tax subsidy for advertising unhealthy food to children and setting nutrition standards for other foods and beverages sold in schools) would reduce prevalence by an additional 0.7 percent.

These interventions would have a modest impact on obesity prevalence. Even if all were implemented and the effects were additive, the overall impact would be a reduction of 4.1 percent, or 2.9 million cases of childhood obesity prevented for the population in 2025.

TAX REVENUE In addition to their effects on obesity, we estimated that both the sugar-sweetened beverage excise tax and the elimination of the tax subsidy for advertising unhealthy food to children would lead to substantial yearly tax revenues ($12.5 billion and $80 million, respectively). These revenues were not included in our calculations of net costs.

Discussion

These results indicate that primary prevention of childhood obesity should be the remedy of choice. Four of the interventions studied here have the potential for cost savings—that is, the interventions would cost less to implement than they would save over the next ten years in health care costs—and would result in substantial numbers of childhood obesity cases prevented.

The sugar-sweetened beverage excise tax—and, to a lesser extent, removing the tax deduction for advertising unhealthy food to children—would also generate substantial revenue that could be used to fund other obesity prevention interventions. The excise tax has been the focus of recent policy discussion,[25,31] and the recent enactment of an excise tax of one cent per ounce in Berkeley, California, and the national implementation of an excise tax in Mexico indicate the growing political feasibility of this approach.

The improvements in meal standards in the National School Lunch and School Breakfast Programs as well as implementation of the first meaningful national standards for all other foods and beverages sold in schools make the Healthy, Hunger-Free Kids Act one of the most important national obesity prevention policy achievements in recent decades. Although improving nutrition standards for school meals was not intended primarily as an obesity reduction strategy, we estimated that this intervention—which includes improving the quality of school meals and setting limits on portion sizes—would have the largest impact on reducing childhood obesity of any of the interventions evaluated in this study.

The individual benefits of bariatric surgery and other intensive clinical interventions to treat obesity can be life changing.[32] Another promising new obesity treatment strategy employs low-cost technological approaches—computerized clinical decision support—to effectively reduce excess childhood weight.[33] Our study should in no way discourage ongoing investment in advancing the quality, reach, and cost-effectiveness of clinical obesity treatment. However, our results indicate that with current clinical practice, the United States will not be able to treat its way out of the obesity epidemic. Instead, policy makers will need to expand investment in primary prevention, focusing on interventions with broad population reach, proven individual effectiveness, and low cost of implementation.

We modeled each intervention in this study separately to help policy makers prioritize investment in obesity prevention. However, as the results show, none of the interventions by itself would be sufficient to reverse the obesity epidemic. Instead, policy makers need to develop a multifaceted prevention strategy that spans settings and reaches individuals across the life course.

Because the energy gap that drives excess weight gain among young children is small, and adult obesity is difficult to reverse, interventions early in the life course have the best chance of having a meaningful impact on long-term obesity prevalence and related mortality and health care costs. However, early intervention will not be sufficient if young children at a healthy weight are subsequently introduced into environments that promote excess weight gain later in childhood and in adulthood.

Increased access to adolescent bariatric surgery had the smallest reach and the highest cost per BMI unit reduction. Of the other six interventions that we analyzed, improving early care and education using the NAP SACC model both had the smallest reach, because of the intervention's relatively small age range and voluntary implementation strategy, and was the most costly per BMI unit reduction. Nonetheless, this intervention might still be a good investment, considering that even small changes among very young children can be important for setting a healthier weight trajectory in childhood.

Additionally, the intervention focuses on improvements in nutrition, physical activity, and screen time for all children and thus could have benefits for child development beyond reducing unhealthy weight gain. In contrast to the tax policies we evaluated, which have been met with opposition from industry, the NAP SACC program is well liked and has been widely adopted.

While policy makers should consider the long-term effectiveness of interventions that target young children, substantially reducing health care expenditures due to obesity in the near term will require implementation of strategies that target both children and adults. We estimated that over the decade 2015–25, the beverage excise tax would save $14.2 billion in net costs, primarily due to reductions in adult health care costs. Interventions that can achieve near-term health cost savings among adults and reduce childhood obesity offer policy makers an opportunity to make long-term investments in children's health while generating short-term returns. These results are consistent with previous research that estimated the potential health cost savings and health gains from reducing childhood obesity, much of which resulted from preventing obesity during adulthood.[34]

Conclusion

Reversing the tide of the childhood obesity epidemic will require sustained effort across all levels of government and civil society for the foreseeable future. To make these efforts effective and sustainable during a period of constrained public health resources, policy makers need to integrate the best available evidence on the potential effectiveness, reach, and cost of proposed obesity strategies to prioritize the highest-value interventions.

We found that a number of preventive interventions would have substantial population-level impacts and would be cost-saving. An important question for policy makers is, why are they not actively pursuing cost-effective policies that can prevent childhood obesity and that cost less to implement than they would save for society?

Our results also highlight the critical impact that existing investments in improvements to the school food environment would have on future obesity prevalence and indicate the importance of sustaining these preventive strategies. Furthermore, while many of the preventive interventions in childhood do not provide substantial health care cost savings (because most obesity-related health care costs occur later, in adulthood), childhood interventions have the best chance of substantially reducing obesity prevalence and related mortality and health care costs in the long run.

The focus of action for policy makers should be on implementing cost-effective preventive interventions, ideally ones that would have broad population-level impact. Particularly attractive are interventions that affect both children and adults, so that near-term health care cost savings can be achieved by reducing adult obesity and its health consequences, while laying the groundwork for long-term cost savings by also reducing childhood and adolescent obesity. ■

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NOTES

1 Swinburn BA, Sacks G, Hall KD, McPherson K, Finegood DT, Moodie ML, et al. The global obesity pandemic: shaped by global drivers and local environments. Lancet. 2011; 378(9793):804–14.

2 Gortmaker SL, Swinburn B, Levy D, Carter R, Mabry PL, Finegood D, et al. Changing the future of obesity: science, policy, and action. Lancet. 2011;378(9793):838–47.

3 Institute of Medicine. Preventing childhood obesity: health in the balance. Washington (DC): National Academies Press; 2005.

4 Glickman D, Parker L, Sim LJ, Del Valle Cook H, Miller EA, editors. Accelerating progress in obesity prevention: solving the weight of the nation. Washington (DC): National Academies Press; 2012. p. 462.

5 Black JA, White B, Viner RM, Simmons RK. Bariatric surgery for obese children and adolescents: a systematic review and meta-analysis. Obes Rev. 2013;14(8):634–44.

6 Oude Luttikhuis H, Baur L, Jansen H, Shrewsbury VA, O'Malley C, Stolk RP, et al. Interventions for treating obesity in children. Cochrane Database Syst Rev. 2009(1):CD001872.

7 Kelleher DC, Merrill CT, Cottrell LT, Nadler EP, Burd RS. Recent national trends in the use of adolescent inpatient bariatric surgery: 2000 through 2009. JAMA Pediatr. 2013; 167(2):126–32.

8 Hall KD, Butte NF, Swinburn BA, Chow CC. Dynamics of childhood growth and obesity: development and validation of a quantitative mathematical model. Lancet Diabetes Endocrinol. 2013;1(2):97–105.

9 Hall KD, Sacks G, Chandramohan D, Chow CC, Wang YC, Gortmaker SL, et al. Quantification of the effect of energy imbalance on bodyweight. Lancet. 2011;378(9793):826–37.

10 Wang YC, Orleans CT, Gortmaker SL. Reaching the healthy people goals for reducing childhood obesity: closing the energy gap. Am J Prev Med. 2012;42(5):437–44.

11 To access the Appendix, click on the Appendix link in the box to the right of the article online.

12 Epstein LH, Roemmich JN, Robinson JL, Paluch RA, Winiewicz DD, Fuerch JH, et al. A randomized trial of the effects of reducing television viewing and computer use on body mass index in young children. Arch Pediatr Adolesc Med. 2008; 162(3):239–45.

13 Carter R, Vos T, Moodie M, Haby M, Magnus A, Mihalopoulos C. Priority setting in health: origins, description and application of the Australian Assessing Cost-Effectiveness Initiative. Expert Rev Pharmacoecon Outcomes Res. 2008;8(6):593–617.

14 Carter R, Moodie M, Markwick A, Magnus A, Vos T, Swinburn B, et al. Assessing Cost-Effectiveness in Obesity (ACE-Obesity): an overview of the ACE approach, economic methods, and cost results. BMC Public Health. 2009;9:419.

15 Haby MM, Vos T, Carter R, Moodie M, Markwick A, Magnus A, et al. A new approach to assessing the health benefit from obesity interventions in children and adolescents: the Assessing Cost-Effectiveness in Obesity project. Int J Obes (Lond). 2006;30(10):1463–75.

16 Vos T, Carter R, Barendregt J, Mihalopoulos C, Veerman JL, Magnus A, et al. Assessing Cost-Effectiveness in Prevention (ACE-Prevention): final report. Brisbane: University of Queensland and Deakin University; 2010 Sep [cited 2015 Sep 3]. Available from: http://www.sph.uq.edu.au/docs/BODCE/ACE-P/ACE-Prevention_final_report.pdf

17 Siegel JE, Weinstein MC, Russell LB, Gold MR. Recommendations for reporting cost-effectiveness analyses. Panel on Cost-Effectiveness in Health and Medicine. JAMA. 1996; 276(16):1339–41.

18 Yang YT, Pomeranz JL. States variations in the provision of bariatric surgery under Affordable Care Act exchanges. Surg Obes Relat Dis. 2015;11(3):715–20.

19 Gold MR, Siegel JE, Russell LB, Weinstein MC. Cost-effectiveness in health and medicine. New York (NY): Oxford University Press; 1996.

20 Drummond M, O'Brien B, Stoddart GL, Torrance GW. Methods for the economic evaluation of health care programmes. 2nd ed. Oxford: Oxford University Press; 1997.

21 Guyatt GH, Oxman AD, Kunz R, Vist GE, Falck-Ytter Y, Schünemann H, et al. What is "quality of evidence" and why is it important to clinicians? BMJ. 2008;336(7651):995–8.

22 Higgins JPT, Green S, editors. Cochrane handbook for systematic reviews of interventions: version 5.1.0 [Internet]. London: Cochrane Collaboration; 2011 [cited 2015 Sep 3]. Available from: http://handbook.cochrane.org/

23 Briggs AH. Handling uncertainty in cost-effectiveness models. Pharmacoeconomics. 2000;17(5): 479–500.

24 Gortmaker SL, Long MW, Resch SC, Ward ZJ, Cradock AL, Barrett JL, et al. Cost effectiveness of childhood obesity interventions: evidence and methods for CHOICES. Am J Prev Med. 2015;49(1):102–11.

25 Long MW, Gortmaker SL, Ward ZJ, Resch SC, Moodie ML, Sacks G, et al. Cost effectiveness of a sugar-sweetened beverage excise tax in the US. Am J Prev Med. 2015;49(1):112–23.

26 Sonneville KR, Long MW, Ward ZJ, Resch SC, Wang YC, Pomeranz JL, et al. BMI and healthcare cost impact of eliminating tax subsidy for advertising unhealthy food to youth. Am J Prev Med. 2015;49(1):124–34.

27 Shadish WR, Cook TD, Campbell DT. Experimental and quasi-experimental designs for generalized causal inference. Boston (MA): Houghton Mifflin; 2002.

28 Wang YC, Coxson P, Shen YM, Goldman L, Bibbins-Domingo K. A penny-per-ounce tax on sugar-sweetened beverages would cut health and cost burdens of diabetes. Health Aff (Millwood). 2012;31(1): 199–207.

29 Bruemmer B, Krieger J, Saelens BE, Chan N. Energy, saturated fat, and sodium were lower in entrées at chain restaurants at 18 months compared with 6 months following the implementation of mandatory menu labeling regulation in King County, Washington. J Acad Nutr Diet. 2012;112(8):1169–76.

30 Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of childhood and adult obesity in the United States, 2011–2012. JAMA. 2014;311(8): 806–14.

31 Brownell KD, Farley T, Willett WC, Popkin BM, Chaloupka FJ, Thompson JW, et al. The public health and economic benefits of taxing sugar-sweetened beverages. N Engl J Med. 2009;361(16):1599–605.

32 Dietz W, Baur L, Hall K, Puhl R, Taveras E, Uauy R, et al. Management of obesity: improvement of health-care training and systems for prevention and care. Lancet. 2015; 385(9986):2521–33.

33 Taveras EM, Marshall R, Kleinman KP, Gillman MW, Hacker K, Horan CM, et al. Comparative effectiveness of childhood obesity interventions in pediatric primary care: a cluster-randomized trial. JAMA Pediatr. 2015;169(6):535–42.

34 Trasande L. How much should we invest in preventing childhood obesity? Health Aff (Millwood). 2010; 29(3):372–8.

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ANALYSIS

6 Takeaways Show Strong Progress on School Food and Nutrition

The top milestones from 7 years of work for children's health

April 11, 2017

Kids' Safe and Healthful Foods Project

By Stephanie Scarmo and Whitney Meagher

Students get as much as half of their daily calories from food and drinks served in schools, and research shows that more nutritious choices lead to better health and academic success.

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All families want to give their kids the gift of good health to help young minds and bodies reach their full potential. In making this wish a reality, parents have a powerful ally in the nation's schools, especially the federally funded nutrition programs that serve breakfasts, lunches, and snacks to millions of students every day.

Schools nationwide have improved the quality and variety of the foods and drinks they offer in recent years, thanks in part to new policies and increased funding approved by Congress in 2010. That same year, the Robert Wood Johnson Foundation and The Pew

Charitable Trusts formed the Kids' Safe and Healthful Foods Project (KSHF) to provide nonpartisan, evidence-based recommendations to help policymakers, school nutrition professionals, parents, and other stakeholders navigate the transition to healthier options for all students.

Today, virtually all schools meet the nation's stronger nutrition standards, and the project is nearing completion of its research agenda. Here's a look back at important lessons from our work and other rigorous studies.

The Healthy, Hunger-Free Kids Act of 2010 was a game-changer

In December 2010, Congress passed the Healthy, Hunger-Free Kids Act, reauthorizing federal school meal programs with a focus on improving children's access to nutritious foods and promoting healthy eating. At the time, the average school lunch was high in sodium, calories from solid fats, and added sugars and low in whole grains. The act directed the U.S. Department of Agriculture (USDA) to undertake the first major changes to school meal nutrition standards in more than 15 years.

About a year later, the USDA finalized those updated nutrition standards, making changes that reflected the 2010 Dietary Guidelines for Americans and the most recent science on children's daily nutrient requirements. The updated standards require that meals include more fruits, vegetables, and whole grains and only fat-free or low-fat milk. In addition, they set weekly calorie ranges that rise as students get older and limits on the saturated fat and sodium content. By September 2016, nearly all districts were meeting the healthier standards.

> "Thirty-one million children eat school lunches, and nearly 15 million get school breakfasts on an average day."

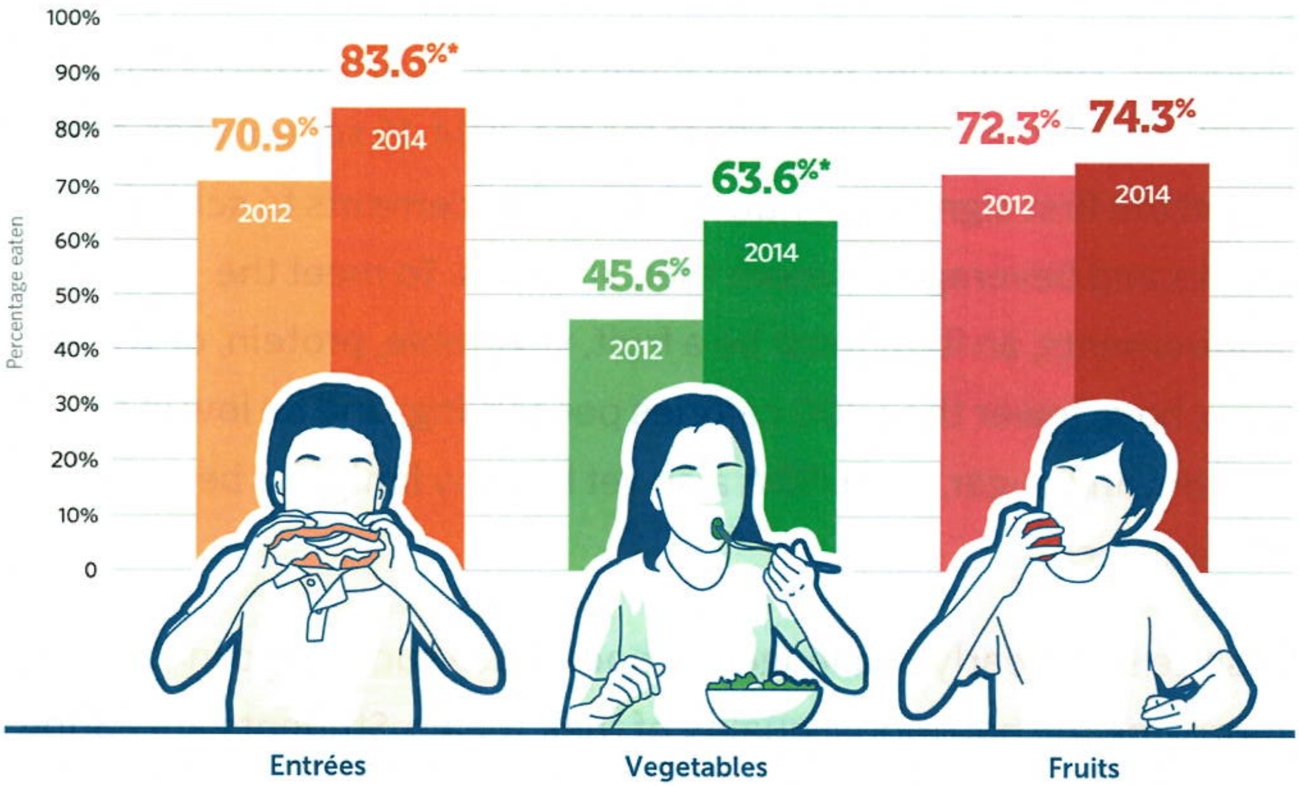
The act also directed the USDA to set science-based nutrition standards for snack foods and beverages sold to students during the school day, such as those purchased from vending machines, a la carte cafeteria lines, and school stores. To inform the department's initial proposal, KSHF conducted a health impact assessment in 2012, which found that children's access to and consumption of healthy snack items and their participation in meal programs would increase with the implementation of stronger standards. A broad range of education and health groups, including KSHF, then urged the USDA to refine the standards and helped generate nearly 250,000 comments from the public on the proposal. The rule that was subsequently issued, known as Smart Snacks in School, went into effect for the 2014-15 school year, and it fueled the first significant nutritional enhancements to school snacks and beverages in more than 30 years. To meet the requirements, an item must be a fruit, vegetable, protein, or whole grain; have fewer than 200 calories per serving; and be low in fat, sodium, and sugar. The USDA also set healthy limits for beverage serving sizes.

Despite some early challenges, schools have succeeded in improving the nutritional quality of their meals. Students are eating more fruits, vegetables, and other healthy foods, and school meal program revenue has held stable or increased. Moreover, many schools are taking advantage of federal grants and other financing strategies to upgrade kitchen equipment, making it easier to prepare more nutritious and delicious meals.

Figure 1

Kids Ate More When School Lunches Got Healthier

Average percentage consumed, by meal component, 2012 and 2014



Notes: Percentages shown are among students who selected the meal component.

* Indicates statistically significant differences at the 5 percent level.

Source: Marlene B. Schwartz et al., "New School Meal Regulations Increase Fruit Consumption and Do Not Increase Total Plate Waste," *Childhood Obesity* 11, no. 3 (2015), http://online.liebertpub.com/doi/pdfplus/10.1089/chi.2015.0019

Students are choosing healthier lunches

Since the updated meal standards were implemented, students of all ages are choosing lunches higher in nutritional quality with fewer calories per gram and consuming more fruits and larger portions of their entrees and vegetables. (See Figure 1.) Studies of schools in three states showed considerable improvements in children's eating habits under the USDA's updated meal standards. Some of these same reports also measured plate waste—the food taken and later discarded by kids—and found that it either stayed the same or declined after the transition to healthier menus.

Parents support healthier school nutrition standards

Polls conducted by KSHF nationally and in 14 states found that most voters with school-age children are concerned about kids' health and support the changes introduced by Congress and the USDA. Nationwide:

- 7 in 10 favor national nutrition standards for school meals and snacks.
- 9 in 10 support requiring schools to include a serving of fruits or vegetables with every meal.
- 3 in 4 back limiting sodium in school meals.

Voters also favored district practices that encourage healthy behaviors. The project's polls in Louisiana, Ohio, and North Carolina asked about school fundraisers, and most respondents said they preferred activity-based events such as car washes or walk-a-thons to food-focused events. On-campus sales of baked goods or items such as pizza and candy during the school day were among the least favored fundraisers.

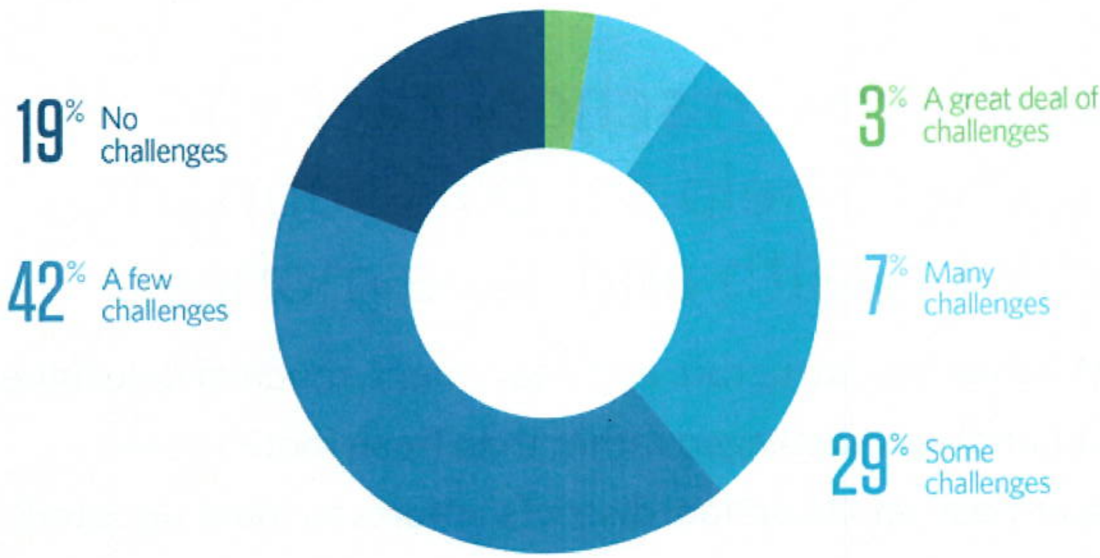
Schools are meeting nutrition standards and promoting healthy eating

A nationally representative survey of school nutrition directors commissioned by KSHF at the end of the 2014-15 school year found that most meal programs use a mix of strategies to encourage students to eat nutritious meals. Nine in 10 adopted at least one practice to raise children's fruit and vegetable consumption. For example, almost two-thirds of directors who increased the use of salad bars said kids ate more produce as a result. Directors also said that holding taste tests with students and redistributing uneaten, sealed foods were among the most effective ways to reduce waste.

Figure 2

More Than 60% of School Meal Directors Had Few or No Difficulties Meeting Healthier Breakfast Standards

Extent of challenges by percentage of respondents, SY 2014-15



Notes: The data are weighted to be representative of all public school food authorities offering the National School Lunch Program. Twenty-seven that do not offer breakfast were excluded.

Source: School Meal Approaches, Resources, and Trends Study, 2015

Directors report stable or rising revenue for school meal programs

The same survey reported that 84 percent of directors saw rising or stable revenue from their combined meal reimbursements plus snack and beverage sales in school year 2014-15 compared with a year earlier. More than half of respondents reported higher combined revenue, and almost a third said total revenue remained level. (See Figure 2.) Among directors who cited financial concerns, equipment and labor costs were most frequently mentioned.

Investments in school kitchen equipment help schools support student health and save money

Aging kitchen infrastructure and equipment, much of it designed to heat or handle prepackaged rather than fresh foods, pose significant barriers to school districts' efforts to meet updated nutrition standards and adapt to the tastes and dietary needs of today's students. Aging equipment is also costly to repair and typically uses greater energy than more modern equipment.

In December 2013, another KSHF survey found that most school meal programs (88 percent) needed one or more pieces of equipment to help them meet nutrition standards, but only 42 percent of respondents reported that they had funding for capital purchases, and less than half of those had a budget that was adequate to meet their equipment needs. Fortunately, between 2009 and 2016, Congress appropriated nearly $200 million for USDA kitchen equipment grants, which helped thousands of schools purchase needed upgrades.

A 2015 KSHF-commissioned series of case studies of 19 schools in seven states explored the effects of these federal kitchen equipment grants on students and meal programs and found that equipment bought with these funds helped many schools overcome challenges reported in the 2013 study. Just one new piece of equipment helped schools improve nutritional quality and variety, entice more students to eat school meals, and operate more efficiently and cost-effectively.

In 2013, in recognition of the need for a sustainable and predictable funding mechanism to support ongoing school kitchen improvements, lawmakers introduced the bipartisan School Food Modernization Act to permanently authorize a USDA kitchen equipment grant program and provide loan assistance for eligible schools. Committees in the House of Representatives and Senate added these provisions to their respective bills to reauthorize child nutrition programs in 2016. Although neither became law before the 114th Congress ended Jan. 3, policymaker support for school kitchen equipment is clearly growing.

Taken together, these facts tell an unmistakable story of transformation in the nation's schools. Cafeterias, vending machines, school stores, and fundraisers are fueling healthier lives for millions of children. Backed by evidence-based policy and funding decisions, school nutrition professionals, advocates, students, and families have driven this progress, and in seven years, they have fundamentally remade school meal programs for America's kids. And even more exciting, it's clear that this movement is just getting started.

MAJOR KIDS' SAFE AND HEALTHFUL FOODS PROJECT PUBLICATIONS, BY DATE

- June 2012—Health Impact Assessment: National Nutrition Standards for Snack and a la Carte Foods and Beverages Sold in Schools
- September 2013—Serving Healthy School Meals: Despite Challenges, Schools Meet USDA Meal Requirements
- December 2013—Serving Healthy School Meals: Kitchen Infrastructure, Training, and Equipment in Schools Workshop
- December 2013—Serving Healthy School Meals: U.S. Schools Need Updated Kitchen Equipment
- September 2014—Parents Support Healthier School Food Policies by 3-to-1 Margin
- August 2015—Serving Healthy School Meals: Staff Development and Training Needs

- May 2016—Changes to the USDA's Child and Adult Care Food Program Can Improve Children's Health: A Review of the Literature on Meal and Snack Nutrition Standard Updates
- June 2016—School Nutrition Gets a Boost From USDA Kitchen Equipment Grants
- December 2016—School Meal Programs Innovate to Improve Student Nutrition

Stephanie Scarmo and Whitney Meagher conduct research on school nutrition programs and policies for the Kids' Safe and Healthful Foods Project.

Related Expert

Stephanie Scarmo
Officer
The Pew Charitable Trusts

MEDIA CONTACT

Matt Mulkey

Manager, Communications
202.862.9864
mmulkey@pewtrusts.org

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bridging the gap

Research Informing Policies & Practices for Healthy Youth

Research Brief
April 2015

Photo credit: Matt Moyer

Improvements in School Lunches Result in Healthier Options for Millions of U.S. Children:

Results from Public Elementary Schools between 2006–07 and 2013–14

Introduction

Most U.S. children's diets exceed recommended levels of sugar, fat, and sodium,[1] and are deficient in fruits, vegetables, and whole grains.[2, 3] In 2009–10, elementary school lunches exceeded recommendations for calories from solid fats and added sugars, and fell short of recommended daily amounts of vegetables and whole grains.[4] As directed by the Healthy, Hunger-Free Kids Act of 2010,[5] the U.S. Department of Agriculture (USDA) updated the national nutrition standards for school meals to align with the 2010 Dietary Guidelines for Americans.[6] These updated standards[7] were announced in January 2012, and schools began to implement them at the beginning of the 2012–13 school year.

The updated standards require schools to offer: a fruit or vegetable daily, a variety of vegetables, and only fat-free or low-fat milk. As of the 2014–15 school year, they also require that 100 percent of grain products offered at lunch be whole-grain rich[8] (up from 50 percent during 2012–13 and 2013–14), although schools may seek exemptions to remain at the 50 percent standard through 2015–16. Some schools had already been meeting these benchmarks prior to 2012–13, but the updated standards led to widespread changes to meals served at most schools.

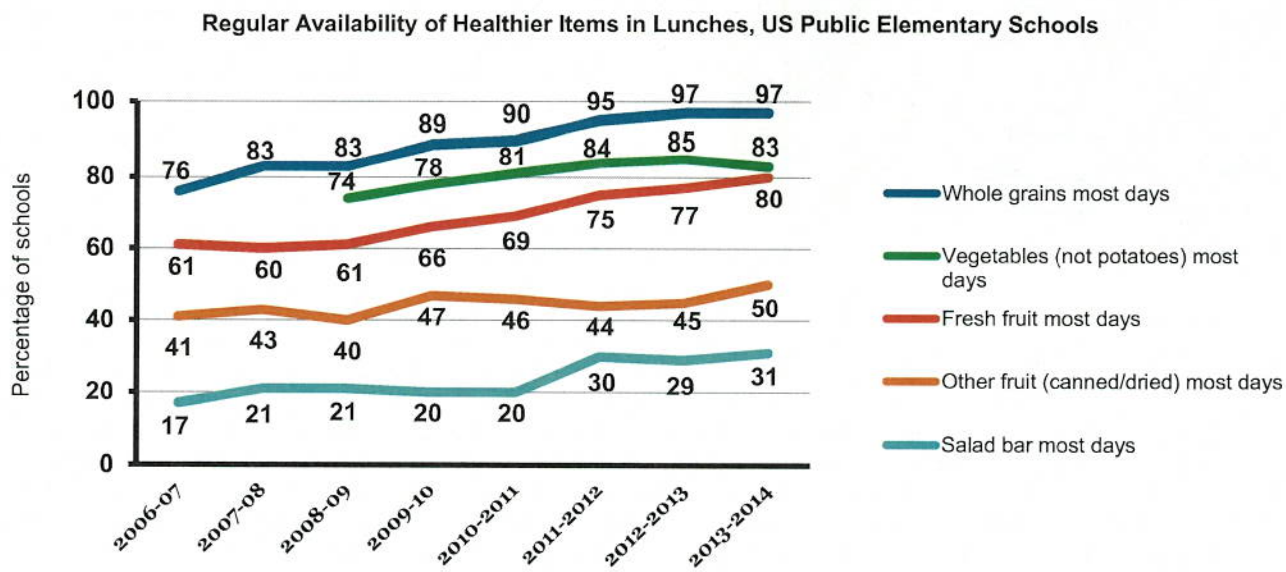
This brief uses data from surveys of elementary schools to examine: a) how the types of items offered in school lunches have changed over time; and b) whether the variety of healthy options changed from the first to the second year of updated standards.

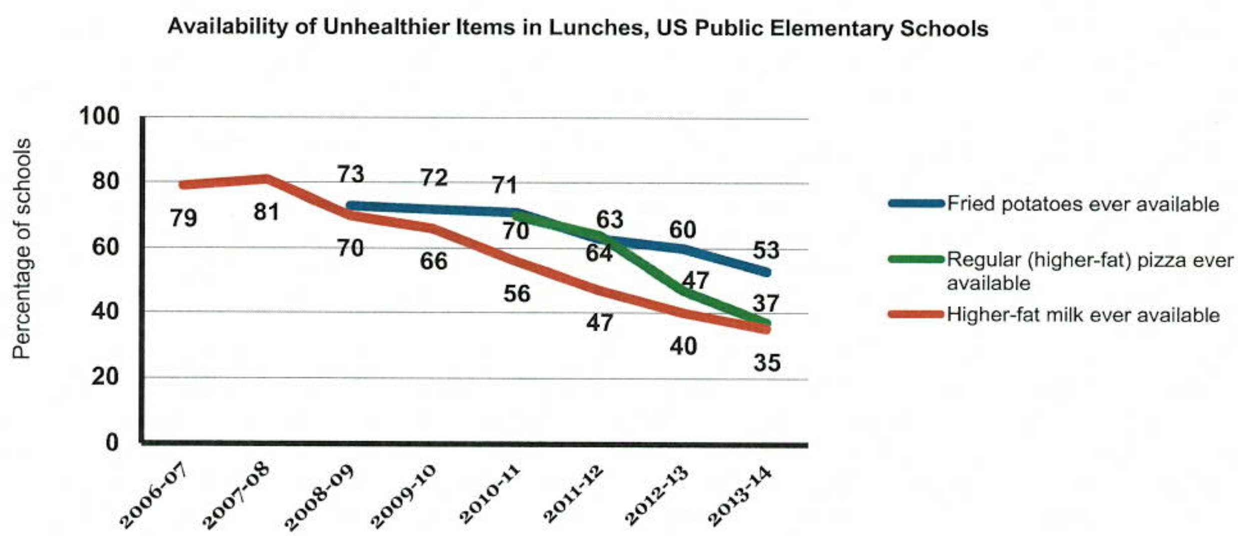
This brief reports on nationally representative data obtained from administrators and food service personnel at U.S. public elementary schools between the 2006–07 and 2013–14 school years. These data do not allow for evaluation of whether a specific school was in compliance with the new meal standards, but they do provide an indication of trends in the availability of healthier items (i.e., a variety of vegetables, fresh fruits, salad bars, and whole grains) and unhealthier items that tend to be high in fat and sodium (i.e., fried potatoes, regular pizza, and higher-fat milks). In 2013–14, the survey included several items assessing changes in lunch characteristics from 2012–13 to 2013–14. Additional detail on the methods used for this study are available online.[9]

The results show that elementary school lunches have been improving consistently since the 2006–07 school year, with more schools offering healthier items and fewer schools offering unhealthier items. This trend has continued through the implementation of national standards in 2012–13, as the overwhelming majority of schools maintained or improved their offerings in the second year of implementation as compared with the first. Together, these findings suggest that elementary schools are able to successfully offer healthier lunches to students and that the national standards are consistent with those efforts.

Key Findings

Significantly more elementary schools were regularly offering healthier items in lunches in 2013–14 than in 2006–07. The availability of unhealthier items in school lunches also decreased notably during the same period.



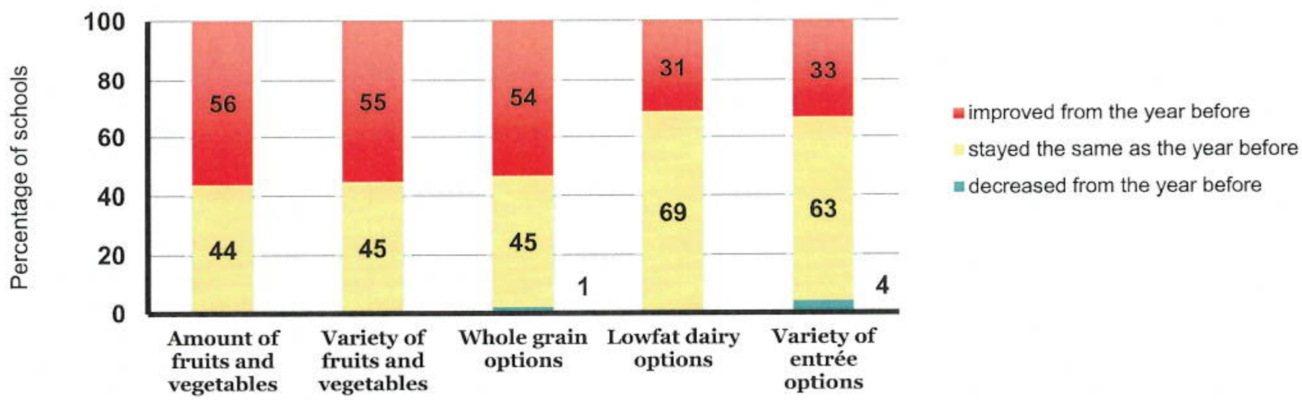


Key Findings

All schools either increased or maintained the amount and variety of fruits and vegetables offered since the standards went into effect in 2012–13.

- At more than half of elementary schools, lunches in 2013–14 included more fruits and vegetables and whole grains, as well as a greater variety of fruits and vegetables, than in 2012–13.
- The majority of schools maintained the same variety of entrée options as in 2012–13, although 33 percent of schools actually increased entrée variety.

Changes in Lunches at US Public Elementary Schools, Reported in 2013–14 School Year



Conclusions and Policy Implications

School lunches have changed considerably over time, with significant improvements documented particularly in recent years. The recent updates to the national nutrition standards are consistent with these improvements. A March 2015 study shows that since the implementation of the new lunch standards—which require students to take either a fruit or vegetable at each meal—students are selecting and eating more fruit, and throwing away less food than they did before the changes were implemented.[10] Recent surveys also show that many students have adapted well to the revised meals, with few complaints.[11] It is essential for policymakers to continue to support implementation of the healthier standards for school meals to support optimal nutrition and health for millions of U.S. children and adolescents.

Endnotes

1. Clark MA, Fox MK. Nutritional quality of the diets of US public school children and the role of the school meal programs. *Journal of the American Dietetic Association*. 2009;109:S44I-S56.
2. Guenther PM, Dodd K, Reedy J, Krebs-Smith S. Most Americans eat much less than recommended amounts of fruits and vegetables. *Journal of the American Dietetic Association*. 2006;106:1371-1379.
3. Krebs-Smith SM, Guenther PM, Subar AF, Kirkpatrick SI, Dodd KW. Americans do not meet federal dietary recommendations. *Journal of Nutrition*. 2010;140(10):1832-1838.
4. Fox MK, Condon E. *School Nutrition Dietary Assessment IV: Summary of Findings*. 2012. www.mathematicampr.com/publications/PDFs/nutrition/snda-iv_findings.pdf
5. United States Department of Agriculture. *The Healthy, Hunger-Free Kids Act of 2010*. www.fns.usda.gov/cnd/Governance/ Legislation/CNR_2010.htm
6. United States Department of Agriculture and United States Department of Health and Human Services. *Dietary Guidelines for Americans 2010*. Washington, DC: U.S. Government Printing Office. 2010.
7. United States Department of Agriculture. Final Rule: Nutrition Standards in the National School Lunch and School Breakfast Programs. 2012. www.gpo.gov/fdsys/pkg/FR-2012-01-26/pdf/2012-1010.pdf
8. Kline A. Requests for exemption from the school meals' whole grain-rich requirement for school years 2014-15 and 2015-16. U.S. Department of Agriculture. http://origin.drupal.fns.usda.gov/sites/default/files/cnd/SP20-2015os.pdf
9. Turner L, Chaloupka FJ. Bridging the Gap's Food and Fitness elementary school survey: technical report on survey development, sampling, and methodology. http://bridgingthegapresearch.org/_asset/34zbxw/BTG_Food_Fitness_ES_survey_methodology_Apr_2015.pdf
10. Schwartz MB, Henderson KE, Read M, Danna N, Ickovics JR. New school meal regulations increase fruit consumption and do not increase total plate waste. *Childhood Obesity*. 2015. Online first: http://online.liebertpub.com/doi/pdfplus/10.1089/chi.2015.0019
11. Turner L, Chaloupka FJ. Perceived reactions of elementary school students to changes in school lunches after implementation of the United States Department of Agriculture's new meals standards: minimal backlash, but rural and socioeconomic disparities exist. *Childhood Obesity*. 2014;10(4);1-8.

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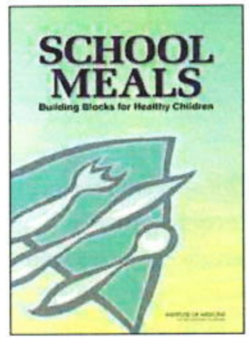
For more on this Research Brief, contact:
Lindsey Turner
LindseyTurner1@boisestate.edu

Bridging the Gap is a nationally recognized research program of the Robert Wood Johnson Foundation dedicated to improving the understanding of how policies and environmental factors affect diet, physical activity and obesity among youth, as well as youth tobacco use. For more information, visit www.bridgingthegapresearch.org and follow us on Twitter: @BTGresearch.

REPORT BRIEF • OCTOBER 2009

School Meals: Building Blocks for Healthy Children



Two national programs—the National School Lunch Program (NSLP) and the School Breakfast Program (SBP)—play key roles in supporting the nutrition and health of schoolchildren in the United States by providing nutritionally balanced, low-cost or free lunches each school day. In 2008, the NSLP provided lunch to more than 30.5 million children, and the SBP provided breakfast to 10.5 million children.

Currently, to receive federal reimbursement, school meals must meet regulations that were established in 1995 for Nutrition Standards and Meal Requirements. The complex set of regulations specifies amounts of nutrients that must be provided, meal planning approaches, and rules for the food that must be on the student's tray. Advances have been made in dietary guidance in the years since those regulations were established. To obtain assistance in updating the regulations, the U.S. Department of Agriculture (USDA) asked the Institute of Medicine (IOM) to provide recommendations to revise the standards and requirements for both the NSLP and the SBP.

To meet its task, an IOM committee reviewed and assessed the food and nutritional needs of school-aged children in the United States using the 2005 *Dietary Guidelines for Americans* set by the Department of Health and Human Services (HHS) and USDA, as well as the IOM's Dietary Reference Intakes (DRI). Furthermore, the committee reviewed the current regulations for the NSLP and SBP Nutrition Standards and Meal Requirements. The committee recommends numerous revisions and that emphasis be placed on revised Meal Requirements rather than on nutrients per se. The committee's recommended new approach clearly focuses on providing meals that are consistent with the *Dietary Guidelines for Americans*.

The committee's recommended new approach clearly focuses on providing meals that are consistent with the *Dietary Guidelines for Americans*.

RECOMMENDED MEAL REQUIREMENTS

The committee makes recommendations for Meal Requirements, which encompass two types of standards: 1) standards for menu planning and 2) standards for meals as selected by the student (in contrast to those that are simply offered to students). Standards are needed for meals as selected because, by law, all high schools are required to allow students to decline a specified number of food items (to reduce waste), and other schools may choose to do so (a majority of them do so).

In order to align school meals with the *Dietary Guidelines for Americans* and improve the healthfulness of school meals, the committee recommends that the Food and Nutrition Service of the USDA adopt standards for menu planning that:

- increase the amount and variety of fruits, vegetables, and whole grains;
- set a minimum and maximum level of calories; and
- increase the focus on reducing the amounts of saturated fat and sodium provided.

The committee recommends a single approach to menu planning—one that includes a meal pattern (which specifies the types and amounts of food in the meal) plus specifications for minimum and maximum calorie levels, maximum saturated fat content, and maximum sodium content. Some of the recommended changes are described in Table 1. Because the meal pattern alone cannot ensure appropriate amounts of calories, saturated fat, and sodium, the committee set specifications for those three dietary components. The combination results in meals that are nutrient-rich but moderate in calories.

The committee recommends a single approach to menu planning—one that includes a meal pattern plus specifications for minimum and maximum calorie levels, maximum saturated fat content, and maximum sodium content.

TABLE 1: KEY RECOMMENDED CHANGES IN SCHOOL LUNCH REQUIREMENTS

Type of Specification	Current Requirements	Recommendations
Fruits	Considered together as a fruit and vegetable group. No specifications for the type of vegetable	Required daily amount increased
Vegetables		Two servings required daily, amount increased. Must include dark green, bright orange, legumes, starchy, and other vegetables each week
Grains/ Breads	No requirement for whole grains	At least half must be whole grain rich
Milk	Whole, reduced-fat, low-fat, fat-free milks (plain or flavored)	Fat-free (plain or flavored) and plain low-fat milk only
Calories	Must meet minimum level	Must be within minimum and maximum level
Sodium	None (decreased level recommended)	Gradually but markedly decrease sodium to the specified level by 2020

The committee developed two options for the standards for meals as selected by the student. The options differ in the number of food items that may be declined, but both of the options include a new specification: that the student must select a fruit at breakfast and either a fruit or a vegetable at lunch for the meal to be reimbursable.

NUTRIENT TARGETS

The current Nutrition Standards include eight specific requirements covering calories, fat, protein, and several vitamins and minerals. To achieve consistency with *Dietary Guidelines* and the DRIs, however, the committee found it necessary to increase the number of nutrients considered and, using a new concept, to replace Nutrition Standards with Nutrient Targets. The committee developed the Nutrient Targets (which encompass 24 nutrients and other dietary components) as guidelines to determine the amount and type of food groups to be offered to students. These are not intended to be used as specific requirements for menu planning or to monitor menus, as is the case with the current Nutrition Standards.

The committee stresses the importance of reducing the sodium content of foods and, therefore, recommends that USDA work cooperatively with HHS, the food industry, professional organizations, state agencies, advocacy groups, and parents to develop strategies and incentives to achieve such a task. The committee recognizes that there are barriers to reducing the sodium content of meals to the levels that are recommended without having adverse effects on student acceptance and participation, safety, practicality, and cost. In recognition of the barriers, the committee suggests that implementation be fully achieved by 2020; and it proposes that intermediate targets be set at two-year intervals and periodically evaluated to promote step-wise reductions in sodium content over the decade beginning in 2010.

RECOMMENDATIONS FOR IMPLEMENTATION AND MONITORING

The manner in which Meal Requirements are implemented and monitored will determine whether students participate in the NSLP and SBP and consume the food that is offered. Important implementation strategies to promote change and increase student participation in the program include engaging the school community; involving students, parents, and the community; providing nutrition education; training and mentoring food service workers; and providing technical assistance. Industry involvement will be essential to the implementation process, including the introduction of appealing foods that are lower in sodium and saturated fat and those that have a higher ratio of whole grain to refined grain. In addition, new monitoring procedures will guide implementation efforts.

Recommended support from the Food and Nutrition Service includes:

- Technical assistance for developing and continuously improving menus, ordering appropriate foods (including the writing of specifications), and controlling costs while maintaining quality.
- New procedures for monitoring the quality of school meals that (1) focus on meeting relevant *Dietary Guidelines*, and (2) provide information for continuous quality improvement and for mentoring food service workers to assist in performance improvement.

CONCLUSION

Since the NSLP's inception, more than 219 billion lunches have been served. Implementation of the committee's recommendations will lead to healthier meals in the NSLP and the SBP—meals that are much more consistent with *Dietary Guidelines for Americans*. With comprehensive technical assistance from USDA and the support and involvement of state agencies, professional organizations, the food industry, child advocacy groups, schools, parents, and students, these school meals will appeal to students and contribute to their health and well being.

With comprehensive technical assistance from USDA and the support and involvement of state agencies, professional organizations, the food industry, child advocacy groups, schools, parents, and students, these school meals will appeal to students and contribute to their health and well being.

FOR MORE INFORMATION . . .

Copies of *School Meals: Building Blocks for Healthy Children* are available from the National Academies Press, 500 Fifth Street, N.W., Lockbox 285, Washington, DC 20055; (800) 624-6242 or (202) 334-3313 (in the Washington metropolitan area); Internet, www.nap.edu. The full text of this report is available at www.nap.edu.

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COMMITTEE ON NUTRITION STANDARDS FOR NATIONAL SCHOOL LUNCH AND BREAKFAST PROGRAMS

VIRGINIA A. STALLINGS, (Chair), The Children's Hospital of Philadelphia, University of Pennsylvania; **KAREN WEBER CULLEN**, Children's Nutrition Research Center, Baylor College of Medicine, Houston,TX; **ROSEMARY DEDERICHS**, Minneapolis Public Schools, Special School District No. 1, MN; **MARY KAY FOX**, Mathematica Policy Research, Inc., Cambridge, MA; **LISA HARNACK**, Division of Epidemiology and Community Health, University of Minnesota, MN; **GAIL HARRISON**, School of Public Health, Center for Health Policy Research, University of California, Los Angeles; **MARY ARLINDA HILL**, Jackson Public Schools, MS; **HELEN H. JENSEN**, Department of Economics, Iowa State University, Ames; **RONALD E. KLEINMAN**, Massachusetts General Hospital for Children, Harvard Medical School, Boston, MA; **GEORGE P. McCABE**, College of Science, Purdue University, West Lafayette, IN; **SUZANNE P. MURPHY**, Cancer Research Center of Hawaii, University of Hawaii, Honolulu; **ANGELA ODOMS-YOUNG**, Department of Kinesiology and Nutrition, University of Illinois at Chicago, IL; **YEONHWA PARK**, Department of Food Science, University of Massachusetts, Amherst; **MARY JO TUCKWELL**, in-TEAM Associates, Ashland, WI

STUDY STAFF

CHRISTINE TAYLOR, Study Director; **SHEILA MOATS**, Associate Program Officer; **JULIA HOGLUND**, Research Associate; **HEATHER BREINER**, Program Associate; **CAROL WEST SUITOR**, Consultant Subject Matter Expert and Writer; **ANTON BANDY**, Financial Officer; **GERALDINE KENNEDO**, Administrative Assistant, Food and Nutrition Board; **LINDA D. MEYERS**, Director, Food and Nutrition Board

TABLE S-1 Recommended *as Offered* Meal Standards

	Breakfast			Lunch		
	Grades K–5	Grades 6–8	Grades 9–12	Grades K–5	Grades 6–8	Grades 9–12
Meal Pattern	Amount of Foods[a] Per Week					
Fruits (cups)[b]	5	5	5	2.5	2.5	5
Vegetables (cups)[b]	0	0	0	3.75	3.75	5
Dark green	0	0	0	0.5[c]	0.5[c]	0.5[c]
Orange	0	0	0	0.5[c]	0.5[c]	0.5[c]
Legumes	0	0	0	0.5[c]	0.5[c]	0.5[c]
Starchy	0	0	0	1	1	1
Other	0	0	0	1.25[c]	1.25[c]	2.5[c]
Grains, at least half of which must be whole grain-rich[d] (oz eq)	7–10	8–10	9–10	9–10	9–10	12–13
Meats, beans, cheese, yogurt (oz eq)	5	5	7–10	8–10	9–10	10–12
Fat-free milk (plain or flavored) or low-fat milk (1% milk fat or less) (cups)	5	5	5	5	5	5
Other Specifications	Other Specifications: Daily Amount Based on the Average for a 5-Day Week					
Min-max calories (kcal)[e,f]	350–500	400–550	450–600	550–650	600–700	750–850
Saturated fat (% of total calories)[g]	< 10	< 10	< 10	< 10	< 10	< 10
Sodium (mg)	[≤ 430]	[≤ 470]	[≤ 500]	[≤ 640]	[≤ 710]	[≤ 740]
	Sodium targets are to be reached by the year 2020.[h]					
trans fat	Nutrition label must specify zero grams of *trans* fat per serving.[i]					

NOTES: K = kindergarten; kcal = calories; max = maximum; mg = milligrams; min = minimum; oz eq = ounce equivalent. Although the recommended weekly meal intake patterns do not specify amounts of unsaturated oils, their use is to be encouraged within calorie limits.

[a]Food items included in each group and subgroup and amount equivalents. Appendix Table H-1 gives a listing of foods by food group and subgroup. Minimum daily requirements apply: 1/5 of the weekly requirement for fruits, total vegetables, and milk and at least 1oz equivalent each of grains and meat or meat alternate (2 oz of each for grades 9–12 lunch).

[b]One cup of fruits and vegetables usually provides two servings; ¼ cup of dried fruit counts as ½ cup of fruit; 1 cup of leafy greens counts as ½ cup of vegetables. No more than half of the fruit offerings may be in the form of juice.

[c]Larger amounts of these vegetables may be served.

[d]Based on at least half of the grain content as whole grain. Aiming for a higher proportion of whole grain-rich foods is encouraged. See Box 7-1 for Temporary Criterion for Whole-Grain Rich Foods. Also note that in Chapter 10 the committee recommends that the Food Buying Guide serving sizes be updated to be consistent with MyPyramid Equivalent serving sizes.

[e]The average daily amount for a 5-day school week is not to be less than the minimum or exceed the maximum.

[f]Discretionary sources of calories (for example, solid fats and added sugars) may be added to the meal pattern if within the specifications for calories, saturated fat, *trans* fat, and sodium.

[g]The average daily amount for a 5-day school week is not to exceed the maximum.

[h]To ensure that action is taken to reduce the sodium content of school meals over the 10-year period in a manner that maintains student participation rates, the committee suggests the setting of intermediate targets for each 2-year interval. (See the section "Achieving Long-Term Goals" in Chapter 10.)

[i]Because the nutrition facts panel is not required for foods with Child Nutrition labeling, the committee suggests that only products with 0 grams of *trans* fat per serving be eligible for consideration for such labeling.

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By Steven L. Gortmaker, Y. Claire Wang, Michael W. Long, Catherine M. Giles, Zachary J. Ward, Jessica L. Barrett, Erica L. Kenney, Kendrin R. Sonneville, Amna Sadaf Afzal, Stephen C. Resch, and Angie L. Cradock

Three Interventions That Reduce Childhood Obesity Are Projected To Save More Than They Cost To Implement

Steven L. Gortmaker (sgortmak@hsph.harvard.edu) is a professor of the practice of health sociology at the Harvard T.H. Chan School of Public Health, in Boston, Massachusetts.

Y. Claire Wang is an associate professor at the Mailman School of Public Health, Columbia University, in New York City.

Michael W. Long is an assistant professor at the Milken Institute School of Public Health, the George Washington University, in Washington, DC.

Catherine M. Giles is a program manager at the Harvard T.H. Chan School of Public Health.

Zachary J. Ward is a programmer analyst at the Harvard T.H. Chan School of Public Health.

Jessica L. Barrett is a research assistant IV at the Harvard T.H. Chan School of Public Health.

Erica L. Kenney is a postdoctoral research fellow at the Harvard T.H. Chan School of Public Health.

Kendrin R. Sonneville is an assistant professor at the University of Michigan School of Public Health, in Ann Arbor.

Amna Sadaf Afzal is an assistant professor at the Albert Einstein College of Medicine, in New York City.

ABSTRACT **Policy makers seeking to reduce childhood obesity must prioritize investment in treatment and primary prevention. We estimated the cost-effectiveness of seven interventions high on the obesity policy agenda: a sugar-sweetened beverage excise tax; elimination of the tax subsidy for advertising unhealthy food to children; restaurant menu calorie labeling; nutrition standards for school meals; nutrition standards for all other food and beverages sold in schools; improved early care and education; and increased access to adolescent bariatric surgery. We used systematic reviews and a microsimulation model of national implementation of the interventions over the period 2015–25 to estimate their impact on obesity prevalence and their cost-effectiveness for reducing the body mass index of individuals. In our model, three of the seven interventions—excise tax, elimination of the tax deduction, and nutrition standards for food and beverages sold in schools outside of meals—saved more in health care costs than they cost to implement. Each of the three interventions prevented 129,000–576,000 cases of childhood obesity in 2025. Adolescent bariatric surgery had a negligible impact on obesity prevalence. Our results highlight the importance of primary prevention for policy makers aiming to reduce childhood obesity.**

The childhood obesity epidemic in the United States affects all segments of society. There is a clear need for action by governments, foundations, and other relevant institutions to address this public health problem. Controlling childhood obesity is complex because many risk behaviors are involved, shaped by multiple environments and requiring multiple intervention strategies.[1–4] However, simply asking what works without considering costs has led to the proliferation of obesity treatment and prevention initiatives with limited evaluative information. Little serious discussion has taken place about relative costs or cost-effectiveness. When we searched the PubMed database of the National Library of Medicine for articles published through 2014 containing the term *child obesity*, we found more than 31,000, but only 89 of these also contained the term *cost-effectiveness*. Communities and health agencies have limited resources to address high rates of childhood obesity and need to know how best to invest those resources.

There are two main approaches to altering the population prevalence of obesity in children: treating obesity after onset and preventing excess weight gain (primary prevention). Many studies have documented the effectiveness of interventions using these two different approaches. For example, a meta-analysis of adolescent bariatric surgery studies indicates an average reduction in body mass index (BMI) of 13.5 kg/m^2 following this procedure.[5] Some nonsurgical interventions to treat childhood obesity are effective, but effect sizes are small relative to the high BMIs (or BMI z-scores—that is, BMI scores that are standardized for age and sex) of the children before the intervention,[6] and treatments may reach too few children to have a substantial population-level impact. For example, bariatric surgery is used with only about 1,000 adolescents per year.[7]

The promise of primary prevention strategies during childhood has been bolstered by recent findings generated by mathematical models of the physiological development of excess weight in children, adolescents, and adults.[8,9] Modeling indicates that excess weight accumulates slowly, and excess weight gain among young children is due to relatively small changes in energy balance.

For example, among children ages 2–5, average excess weight gain is driven by an excess of about 33 extra kilocalories per day.[10] Changes needed to prevent excess weight gain and prevent obesity are thus quite small in childhood. By adolescence, however, excess weight has accumulated for more than a decade, with an average imbalance of almost 200 extra kcal/day.[8,10] The typical adult with a BMI greater than 35 (about 14 percent of the adult population) consumes 500 kcal/day more than is needed to maintain a healthy body weight.[9] Improving energy balance via improved diet and physical activity early in childhood thus requires much smaller changes than those needed once obesity is established in adolescence and adulthood.

In addition, a large body of experimental evidence indicates that certain behavioral changes can reduce BMI and obesity prevalence in children. For example, as documented in online Appendix A1,[11] there is clear evidence of the effectiveness of reducing the intake of sugar-sweetened beverages on reducing BMI and obesity prevalence.

There is also strong evidence that reducing television viewing and other screen time leads to significant reductions in BMI and obesity prevalence, mainly via dietary changes[12] (also documented in Appendix A2).[11] Despite growing evidence that targeted interventions can improve diet and reduce BMI and obesity prevalence, there is limited evidence concerning the cost-effectiveness of these approaches and the potential US population–level impact of either treatment or preventive interventions.

In this article we present results of an evidence review and microsimulation modeling project concerning the cost-effectiveness and population-level impact of seven interventions identified as potentially important strategies for addressing childhood obesity. We conducted systematic evidence reviews of the interventions' effectiveness and estimated costs and reach under specified implementation scenarios described in Appendices A1, A2, and A4–A8.[11] We developed a microsimulation model to assess key cost-effectiveness metrics of these interventions if they were to be implemented nationally.

Stephen C. Resch is deputy director of the Center for Health Decision Science at the Harvard T.H. Chan School of Public Health.

Angie L. Cradock is a senior research scientist at the Harvard T.H. Chan School of Public Health.

Study Data And Methods

We developed an evidence review process and microsimulation model to evaluate the cost-effectiveness of interventions for childhood obesity. Our modeling framework built on the Australian Assessing Cost-Effectiveness approach[13,14] in obesity[15] and prevention studies.[16] Our microsimulation model used US population, mortality, and health care cost data. We focused on outcomes of cost per BMI unit change over two years following an intervention and ten-year changes in obesity, health care costs, and net costs. We followed recommendations of the US Panel on Cost-Effectiveness in Health and Medicine in reporting our results, including using a 3 percent discount rate.[17]

Our approach has distinct methodological components designed to improve both the strength of evidence and the applicability of results to real-world decision making. We created a stakeholder group of thirty-two US policy makers, researchers, and nutrition and physical activity experts to provide advice concerning the selection of interventions, evaluation of data, analyses, and implementation and equity issues. This group advised us to look broadly for interventions to evaluate across settings and sectors. The clinical subgroup selected adolescent bariatric surgery as an important benchmark clinical intervention to evaluate, since many insurers pay for this treatment.[18]

INTERVENTIONS Our stakeholder group selected for the study seven interventions that are high on the treatment and prevention policy agenda (further details about the interventions are provided in the Appendices).[11] The interventions are as follows: an excise tax of one cent per ounce on sugar-sweetened beverages, applied nationally and administered at the state level; the elimination of the tax deductibility of advertising costs for television ads seen by children and adolescents for nutritionally poor foods and beverages; restaurant menu calorie labeling, modeled on the federal menu regulations to be implemented under the Affordable Care Act; implementation of nutrition standards for federally reimbursable school meals sold through the National School

Lunch and School Breakfast Programs, modeled on US Department of Agriculture (USDA) regulations implemented under the Healthy, Hunger-Free Kids Act of 2010; implementation of nutrition standards for all foods and beverages sold in schools outside of reimbursable school meals, modeled on USDA regulations implemented under the Healthy, Hunger-Free Kids Act; improved early childhood education policies and practices, including the national dissemination of the Nutrition and Physical Activity Self-Assessment for Child Care (NAP SACC) program; and a nationwide fourfold increase in the use of adolescent bariatric surgery.

INTERVENTION SPECIFICATIONS, IMPLEMENTATION SCENARIOS, AND COSTS We specified a national implementation scenario for each of the interventions using the best available data for population eligibility and costs at each level of implementation, from recruitment to outcomes. Costing followed standard guidelines[19,20] (for details of models and costing, see Appendix A3).[11] All costs were calculated in 2014 dollars and adjusted for inflation using the Consumer Price Index for all nonmedical costs and the Medical Care Consumer Price Index for medical costs.

EVIDENCE REVIEWS OF INTERVENTION EFFECTS We estimated the effects of each of the seven interventions using an evidence review process consistent with the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) approach[21] and guidelines from the Cochrane Collaboration.[22] Details of the evidence reviews for the interventions are provided in Appendices A1, A2, and A4–A8.[11]

MICROSIMULATION MODEL We developed a microsimulation model to calculate the costs and effectiveness of the interventions through their impact on BMI changes, obesity prevalence, and obesity-related health care costs over ten years (2015–25). This is a stochastic, discrete-time, individual-level microsimulation model of the US population designed to simulate the experience of the population from 2015 to 2025.

The model used data from the Census Bureau, American Community Survey, Behavioral Risk Factor Surveillance System, National Health and Nutrition Examination Surveys (NHANES), and National Survey of Children's Health. It also used longitudinal data about weight and height from the National Longitudinal Survey of Youth, National Longitudinal Study of Adolescent to Adult Health, Early Childhood Longitudinal Study—Kindergarten, Panel Survey of Income Dynamics, and NHANES I Epidemiologic Followup Study.

We used smoking initiation and cessation rates from the National Health Interview Surveys and mortality rates by smoking status and BMI from the NIH-AARP Diet and Health Study. Details of the data, analyses, and model are provided in Appendix A3, and key model input parameters are listed in Appendix Exhibit A3.1.[11]

The estimated effects of the interventions on health care costs were based on national analyses that indicated excess health care costs associated with obesity among children and adults (see Appendix A3).[11] We assumed that each intervention took time—typically 18–36 months—to decrease the BMI of individuals who received each intervention.[8,9] Estimates of intervention costs included one-time start-up and ongoing costs, as well as enforcement and compliance costs, but did not include costs of passing a policy. The annual costs for each intervention are the average of its discounted total costs.

We used a "modified" societal perspective on costs. This means that we did not include several possible economic impacts of the interventions, such as productivity losses associated with obesity or patient costs for items such as transportation to clinic visits or the value of time spent seeking or receiving medical care. It was reasonable to exclude these economic impacts because they are difficult to estimate systematically and likely to be small within a ten-year period, relative to the intervention and health care costs.

We assumed that effects were sustained over the model's time frame—that is, eight years after two start-up years. For policy changes such as the sugar-sweetened beverage excise tax, the elimination of the tax subsidy for advertising unhealthy food to children, and restaurant menu calorie labeling, sustaining an effect for ten years is reasonable, as the changed policy will continue over that period. For the interventions that set nutrition standards for school meals and other foods and beverages sold in schools, we can assume that most children will be exposed to these for a substantial period of time—for example, from first through twelfth grades. For bariatric surgery, we can also assume that the surgical change will persist over this time period.

Details of key input parameters for the interventions modeled where there is known variation from reviews of the relevant literature, including the parameters' distributions and assumptions, are outlined in Appendices A1, A2, and A4–A8.[11] As explained above, all results are expressed in 2014 US dollars and discounted at 3 percent annually.

We calculated costs per BMI units reduced over two years (2015–17). We estimated health care costs, net costs, and net costs saved per dollar spent over ten years (2015–25), since this is a time frame frequently used in policy calculations. We inflated health care costs to 2014 dollars using the Medical Care Consumer Price Index.

We estimated obesity cases prevented and changes in childhood obesity prevalence in 2025, at the end of the period of analysis.

UNCERTAINTY AND SENSITIVITY ANALYSES We calculated probabilistic sensitivity analyses by simultaneously sampling all parameter values from predetermined distributions. We report 95 percent uncertainty intervals (around point estimates) in Exhibits 1 and 2, taking 2.5 and 97.5 percentile values from simulated data.[23] We calculated uncertainty intervals using Monte Carlo simulations programmed in Java over one thousand iterations of the model for a population of one million simulated individuals scaled to the national population size.

CONSULTATION The stakeholder group assisted us in reviewing additional considerations, including quality of evidence, equity, acceptability, feasibility, sustainability, side effects, and impacts on social and policy norms.

LIMITATIONS The study had several limitations. First, its results were based on a simulation model that incorporated a broad range of data inputs. While we included the best available evidence on population characteristics, likely trajectories of obesity prevalence, and obesity-related health care costs, our ability to forecast precise impacts of all of the modeled interventions was limited by the uncertainty around each of these inputs and by the assumptions required to build the model (see Appendix A3).[11]

In previous publications we used a Markov cohort simulation model to estimate the impact of two of the interventions modeled here, the sugar-sweetened beverage excise tax and the elimination of the tax subsidy for advertising unhealthy food to children.[24–26] The cohort model was limited in its ability to model heterogeneity of individual differences, exposure to the intervention, and trajectories of BMI over the life course, and it could not calculate population estimates for specific years. With the microsimulation model, we were able to estimate the number of cases of obesity prevented. For both of these interventions, the estimated costs per BMI unit reduction were similar under both modeling approaches, and both interventions were cost-saving.

Second, we modeled each of the interventions separately, which limited our ability to estimate their cumulative effects. Future obesity prevention simulation modeling should begin to evaluate the impact of simultaneous implementation of multiple interventions.

EXHIBIT 1

Population Reach And Cost For Seven Childhood Obesity Interventions In The United States, 2015–25

Intervention	Population reach (millions)	Intervention cost: Per year ($ millions)	Intervention cost: Per unit of BMI reduced ($)
Sugar-sweetened beverage excise tax	306.6	47.6	2.49
95% UI	306.3, 307.0	31.0, 63.8	0.62, 10.59
Restaurant menu calorie labeling	306.6	95.5	13.09
95% UI	306.3, 307.0	82.7, 108.5	−122.61, 154.42
Elimination of the tax subsidy for advertising unhealthy food to children	72.3	0.82	0.66
95% UI	71.9, 72.8	0.82, 0.82	0.27, 1.13
Nutrition standards for school meals	28.0	1,112	53
95% UI	27.8, 28.2	1,112, 1,112	−185, 186
Nutrition standards for all other food and beverages sold in schools	45.2	22.3	6.10
95% UI	45.0, 45.4	22.3, 22.3	2.34, 7.72
Improved early care and education policies and practices (NAP SACC)	1.18	76.0	613
95% UI	1.14, 1.23	75.8, 76.4	99, 730
Increased access to adolescent bariatric surgery	0.0049	30.3	1,611
95% UI	0.0025, 0.0077	20.9, 40.2	1,241, 2,337

SOURCE Authors' calculations, based on the microsimulation model described in Appendix A3 (see Note 11 in text). **NOTES** Costs are in 2014 dollars. Cost per body mass index (BMI) unit reduction is an incremental cost-effectiveness ratio. UI is uncertainty interval. NAP SACC is Nutrition and Physical Activity Self-Assessment for Child Care.

EXHIBIT 2

Estimated Ten-Year Cost-Effectiveness And Economic Outcomes For Seven Childhood Obesity Interventions In The United States, 2015–25

Intervention	Net costs ($ millions)	Cases of childhood obesity prevented as of 2025	Health care costs saved per dollar spent ($)
Sugar-sweetened beverage excise tax	−14,169	575,936	30.78
95% UI	−47,119, −2,645	131,794, 1,890,715	6.07, 112.94
Restaurant menu calorie labeling	−4,675	41,015	5.90
95% UI	−16,010, 6,284	−41,324, 122,396	−5.06, 18.00
Elimination of the tax subsidy for advertising unhealthy food to children	−260	129,061	32.53
95% UI	−431, −94	48,200, 212,365	12.42, 53.35
Nutrition standards for school meals	6,436	1,815,966	0.42
95% UI	2,458, 12,560	−547,074, 3,381,312	−0.13, 0.78
Nutrition standards for all other food and beverages sold in schools	−792	344,649	4.56
95% UI	−1,339, −251	163,023, 522,285	2.13, 7.01
Improved early care and education policies and practices (NAP SAAC)	731	38,385	0.04
95% UI	706, 754	8,258, 69,111	0.01, 0.07
Increased access to adolescent bariatric surgery	303	—[a]	—[a]
95% UI	209, 401	—[a]	—[a]

SOURCE Authors' calculations based on the microsimulation model described in Appendix A3 (see Note 11 in text). **NOTES** Costs are in 2014 dollars; negative net costs indicate cost savings. Cost-saving interventions result in at least $1 of health care costs saved per $1 spent on the intervention. UI is uncertainty interval. NAP SACC is Nutrition and Physical Activity Self-Assessment for Child Care. [a]Not applicable.

Third, there is limited evidence that directly links the interventions we evaluated to change in population-level obesity prevalence. However, as detailed in Appendices A1, A2, and A4–A8,[11] six of the interventions were supported by randomized trials or natural or quasi-experimental evaluations[27] that linked the intervention or behavioral mechanism targeted by the intervention directly to reductions in BMI for recipients of each intervention. We incorporated uncertainty for all of the underlying model inputs into the probabilistic uncertainty analyses (see Appendix A3.1).[11]

Fourth, because we focused on obesity, we did not incorporate additional health improvements and health care cost reductions due to improvements in diet and physical activity that were independent of reductions in BMI (for example, reductions in diabetes and heart disease).[28]

Study Results

There were large differences in the projected population reach of the interventions (Exhibit 1). The reach of bariatric surgery, the smallest, was very limited, even assuming a fourfold increase in the number of adolescents who receive the procedure. The most recent national data indicate that in 2012, among adolescents classified as having grade 3 obesity (a BMI of roughly 40 or above), fewer than two in a thousand received the procedure (Appendix A8).[11] The largest population reaches occurred with interventions that would affect the whole population, such as the sugar-sweetened beverage excise tax and restaurant menu calorie labeling—both of which would reach 307 million people.

The annual costs of the interventions were driven by both the cost per person and the population reach and varied greatly (Exhibit 1).

Differences across interventions in cost per BMI unit reduction varied more than 2,000-fold. Eliminating the tax deduction for advertising nutritionally poor food to children would reduce a BMI unit for $0.66 per person, while increasing access to bariatric surgery would reduce a BMI unit for $1,611.

Three of the interventions studied were found to be cost-saving across the range of modeled uncertainty: the sugar-sweetened beverage excise tax, eliminating the tax subsidy for advertising unhealthy food to children, and setting nutrition standards for food and beverages sold in schools outside of school meals (Exhibit 2). In other words, these interventions were projected to save more in reduced health costs over the period studied than the interventions would cost to implement. Perhaps more important, the interventions were projected to prevent 576,000, 129,100, and 345,000 cases of childhood obesity, respectively, in 2025. The net savings to society for each dollar spent were projected to be $30.78, $32.53, and $4.56, respectively.

Restaurant menu calorie labeling was also projected to be cost-saving (Exhibit 2), although on average the uncertainty intervals were wide because of the wide uncertainty interval around the estimated per meal reduction in calories ordered or purchased as a result of the intervention (see Appendix A4).[11] This uncertainty highlights the need for ongoing monitoring of this policy when it is implemented nationwide in 2016. Of note, a study of restaurant menu calorie labeling in King County, Washington, found that eighteen months after implementation of menu calorie labeling regulations, restaurants had reduced their calorie content by 41 kilocalories per entrée,[29] a much larger effect than the reduction of 8 kilocalories per meal estimated in this study.

Setting nutrition standards for school meals would reach a very large population of children and have a substantial impact: An estimated 1,816,000 cases of childhood obesity would be prevented, at a cost of $53 per BMI unit change (Exhibits 1 and 2). Improved early care and education policies and practices would reach a much smaller segment of the population (1.18 million), preventing 38,400 childhood obesity cases if implemented nationally, at a cost of $613 per BMI unit change.

The modeled preventive interventions could significantly reduce the overall prevalence of childhood obesity in the United States. Currently, the prevalence of obesity among children and youth is about 17 percent.[30] Based on our model, the largest reduction in childhood obesity prevalence compared to no intervention would occur with the implementation of nutrition standards for school meals (a reduction of 2.6 percent; data not shown), followed by the sugar-sweetened beverage excise tax (0.8 percent). Adding in the two other cost-saving interventions (elimination of the tax subsidy for advertising unhealthy food to children and setting nutrition standards for other foods and beverages sold in schools) would reduce prevalence by an additional 0.7 percent.

These interventions would have a modest impact on obesity prevalence. Even if all were implemented and the effects were additive, the overall impact would be a reduction of 4.1 percent, or 2.9 million cases of childhood obesity prevented for the population in 2025.

TAX REVENUE In addition to their effects on obesity, we estimated that both the sugar-sweetened beverage excise tax and the elimination of the tax subsidy for advertising unhealthy food to children would lead to substantial yearly tax revenues ($12.5 billion and $80 million, respectively). These revenues were not included in our calculations of net costs.

Discussion

These results indicate that primary prevention of childhood obesity should be the remedy of choice. Four of the interventions studied here have the potential for cost savings—that is, the interventions would cost less to implement than they would save over the next ten years in health care costs—and would result in substantial numbers of childhood obesity cases prevented.

The sugar-sweetened beverage excise tax—and, to a lesser extent, removing the tax deduction for advertising unhealthy food to children—would also generate substantial revenue that could be used to fund other obesity prevention interventions. The excise tax has been the focus of recent policy discussion,[25,31] and the recent enactment of an excise tax of one cent per ounce in Berkeley, California, and the national implementation of an excise tax in Mexico indicate the growing political feasibility of this approach.

The improvements in meal standards in the National School Lunch and School Breakfast Programs as well as implementation of the first meaningful national standards for all other foods and beverages sold in schools make the Healthy, Hunger-Free Kids Act one of the most important national obesity prevention policy achievements in recent decades. Although improving nutrition standards for school meals was not intended primarily as an obesity reduction strategy, we estimated that this intervention—which includes improving the quality of school meals and setting limits on portion sizes—would have the largest impact on reducing childhood obesity of any of the interventions evaluated in this study.

The individual benefits of bariatric surgery and other intensive clinical interventions to treat obesity can be life changing.[32] Another promising new obesity treatment strategy employs low-cost technological approaches—computerized clinical decision support—to effectively reduce excess childhood weight.[33] Our study should in no way discourage ongoing investment in advancing the quality, reach, and cost-effectiveness of clinical obesity treatment. However, our results indicate that with current clinical practice, the United States will not be able to treat its way out of the obesity epidemic. Instead, policy makers will need to expand investment in primary prevention, focusing on interventions with broad population reach, proven individual effectiveness, and low cost of implementation.

We modeled each intervention in this study separately to help policy makers prioritize investment in obesity prevention. However, as the results show, none of the interventions by itself would be sufficient to reverse the obesity epidemic. Instead, policy makers need to develop a multifaceted prevention strategy that spans settings and reaches individuals across the life course.

Because the energy gap that drives excess weight gain among young children is small, and adult obesity is difficult to reverse, interventions early in the life course have the best chance of having a meaningful impact on long-term obesity prevalence and related mortality and health care costs. However, early intervention will not be sufficient if young children at a healthy weight are subsequently introduced into environments that promote excess weight gain later in childhood and in adulthood.

Increased access to adolescent bariatric surgery had the smallest reach and the highest cost per BMI unit reduction. Of the other six interventions that we analyzed, improving early care and education using the NAP SACC model both had the smallest reach, because of the intervention's relatively small age range and voluntary implementation strategy, and was the most costly per BMI unit reduction. Nonetheless, this intervention might still be a good investment, considering that even small changes among very young children can be important for setting a healthier weight trajectory in childhood.

Additionally, the intervention focuses on improvements in nutrition, physical activity, and screen time for all children and thus could have benefits for child development beyond reducing unhealthy weight gain. In contrast to the tax policies we evaluated, which have been met with opposition from industry, the NAP SACC program is well liked and has been widely adopted.

While policy makers should consider the long-term effectiveness of interventions that target young children, substantially reducing health care expenditures due to obesity in the near term will require implementation of strategies that target both children and adults. We estimated that over the decade 2015–25, the beverage excise tax would save $14.2 billion in net costs, primarily due to reductions in adult health care costs. Interventions that can achieve near-term health cost savings among adults and reduce childhood obesity offer policy makers an opportunity to make long-term investments in children's health while generating short-term returns. These results are consistent with previous research that estimated the potential health cost savings and health gains from reducing childhood obesity, much of which resulted from preventing obesity during adulthood.[34]

Conclusion

Reversing the tide of the childhood obesity epidemic will require sustained effort across all levels of government and civil society for the foreseeable future. To make these efforts effective and sustainable during a period of constrained public health resources, policy makers need to integrate the best available evidence on the potential effectiveness, reach, and cost of proposed obesity strategies to prioritize the highest-value interventions.

We found that a number of preventive interventions would have substantial population-level impacts and would be cost-saving. An important question for policy makers is, why are they not actively pursuing cost-effective policies that can prevent childhood obesity and that cost less to implement than they would save for society?

Our results also highlight the critical impact that existing investments in improvements to the school food environment would have on future obesity prevalence and indicate the importance of sustaining these preventive strategies. Furthermore, while many of the preventive interventions in childhood do not provide substantial health care cost savings (because most obesity-related health care costs occur later, in adulthood), childhood interventions have the best chance of substantially reducing obesity prevalence and related mortality and health care costs in the long run.

The focus of action for policy makers should be on implementing cost-effective preventive interventions, ideally ones that would have broad population-level impact. Particularly attractive are interventions that affect both children and adults, so that near-term health care cost savings can be achieved by reducing adult obesity and its health consequences, while laying the groundwork for long-term cost savings by also reducing childhood and adolescent obesity. ■

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NOTES

1 Swinburn BA, Sacks G, Hall KD, McPherson K, Finegood DT, Moodie ML, et al. The global obesity pandemic: shaped by global drivers and local environments. Lancet. 2011; 378(9793):804–14.

2 Gortmaker SL, Swinburn B, Levy D, Carter R, Mabry PL, Finegood D, et al. Changing the future of obesity: science, policy, and action. Lancet. 2011;378(9793):838–47.

3 Institute of Medicine. Preventing childhood obesity: health in the balance. Washington (DC): National Academies Press; 2005.

4 Glickman D, Parker L, Sim LJ, Del Valle Cook H, Miller EA, editors. Accelerating progress in obesity prevention: solving the weight of the nation. Washington (DC): National Academies Press; 2012. p. 462.

5 Black JA, White B, Viner RM, Simmons RK. Bariatric surgery for obese children and adolescents: a systematic review and meta-analysis. Obes Rev. 2013;14(8):634–44.

6 Oude Luttikhuis H, Baur L, Jansen H, Shrewsbury VA, O'Malley C, Stolk RP, et al. Interventions for treating obesity in children. Cochrane Database Syst Rev. 2009(1):CD001872.

7 Kelleher DC, Merrill CT, Cottrell LT, Nadler EP, Burd RS. Recent national trends in the use of adolescent inpatient bariatric surgery: 2000 through 2009. JAMA Pediatr. 2013; 167(2):126–32.

8 Hall KD, Butte NF, Swinburn BA, Chow CC. Dynamics of childhood growth and obesity: development and validation of a quantitative mathematical model. Lancet Diabetes Endocrinol. 2013;1(2):97–105.

9 Hall KD, Sacks G, Chandramohan D, Chow CC, Wang YC, Gortmaker SL, et al. Quantification of the effect of energy imbalance on bodyweight. Lancet. 2011;378(9793):826–37.

10 Wang YC, Orleans CT, Gortmaker SL. Reaching the healthy people goals for reducing childhood obesity: closing the energy gap. Am J Prev Med. 2012;42(5):437–44.

11 To access the Appendix, click on the Appendix link in the box to the right of the article online.

12 Epstein LH, Roemmich JN, Robinson JL, Paluch RA, Winiewicz DD, Fuerch JH, et al. A randomized trial of the effects of reducing television viewing and computer use on body mass index in young children. Arch Pediatr Adolesc Med. 2008; 162(3):239–45.

13 Carter R, Vos T, Moodie M, Haby M, Magnus A, Mihalopoulos C. Priority setting in health: origins, description and application of the Australian Assessing Cost-Effectiveness Initiative. Expert Rev Pharmacoecon Outcomes Res. 2008;8(6):593–617.

14 Carter R, Moodie M, Markwick A, Magnus A, Vos T, Swinburn B, et al. Assessing Cost-Effectiveness in Obesity (ACE-Obesity): an overview of the ACE approach, economic methods, and cost results. BMC Public Health. 2009;9:419.

15 Haby MM, Vos T, Carter R, Moodie M, Markwick A, Magnus A, et al. A new approach to assessing the health benefit from obesity interventions in children and adolescents: the Assessing Cost-Effectiveness in Obesity project. Int J Obes (Lond). 2006;30(10):1463–75.

16 Vos T, Carter R, Barendregt J, Mihalopoulos C, Veerman JL, Magnus A, et al. Assessing Cost-Effectiveness in Prevention (ACE-Prevention): final report. Brisbane: University of Queensland and Deakin University; 2010 Sep [cited 2015 Sep 3]. Available from: http://www.sph.uq.edu.au/docs/BODCE/ACE-P/ACE-Prevention_final_report.pdf

17 Siegel JE, Weinstein MC, Russell LB, Gold MR. Recommendations for reporting cost-effectiveness analyses. Panel on Cost-Effectiveness in Health and Medicine. JAMA. 1996; 276(16):1339–41.

18 Yang YT, Pomeranz JL. States variations in the provision of bariatric surgery under Affordable Care Act exchanges. Surg Obes Relat Dis. 2015;11(3):715–20.

19 Gold MR, Siegel JE, Russell LB, Weinstein MC. Cost-effectiveness in health and medicine. New York (NY): Oxford University Press; 1996.

20 Drummond M, O'Brien B, Stoddart GL, Torrance GW. Methods for the economic evaluation of health care programmes. 2nd ed. Oxford: Oxford University Press; 1997.

21 Guyatt GH, Oxman AD, Kunz R, Vist GE, Falck-Ytter Y, Schünemann H, et al. What is "quality of evidence" and why is it important to clinicians? BMJ. 2008;336(7651):995–8.

22 Higgins JPT, Green S, editors. Cochrane handbook for systematic reviews of interventions: version 5.1.0 [Internet]. London: Cochrane Collaboration; 2011 [cited 2015 Sep 3]. Available from: http://handbook.cochrane.org/

23 Briggs AH. Handling uncertainty in cost-effectiveness models. Pharmacoeconomics. 2000;17(5): 479–500.

24 Gortmaker SL, Long MW, Resch SC, Ward ZJ, Cradock AL, Barrett JL, et al. Cost effectiveness of childhood obesity interventions evidence and methods for CHOICES. Am J Prev Med. 2015;49(1):102–11.

25 Long MW, Gortmaker SL, Ward ZJ, Resch SC, Moodie ML, Sacks G, et al. Cost effectiveness of a sugar-sweetened beverage excise tax in the US. Am J Prev Med. 2015;49(1):112–23.

26 Sonneville KR, Long MW, Ward ZJ, Resch SC, Wang YC, Pomeranz JL, et al. BMI and healthcare cost impact of eliminating tax subsidy for advertising unhealthy food to youth. Am J Prev Med. 2015;49(1):124–34.

27 Shadish WR, Cook TD, Campbell DT. Experimental and quasi-experimental designs for generalized causal inference. Boston (MA): Houghton Mifflin; 2002.

28 Wang YC, Coxson P, Shen YM, Goldman L, Bibbins-Domingo K. A penny-per-ounce tax on sugar-sweetened beverages would cut health and cost burdens of diabetes. Health Aff (Millwood). 2012;31(1): 199–207.

29 Bruemmer B, Krieger J, Saelens BE, Chan N. Energy, saturated fat, and sodium were lower in entrées at chain restaurants at 18 months compared with 6 months following the implementation of mandatory menu labeling regulation in King County, Washington. J Acad Nutr Diet. 2012;112(8):1169–76.

30 Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of childhood and adult obesity in the United States, 2011–2012. JAMA. 2014;311(8): 806–14.

31 Brownell KD, Farley T, Willett WC, Popkin BM, Chaloupka FJ, Thompson JW, et al. The public health and economic benefits of taxing sugar-sweetened beverages. N Engl J Med. 2009;361(16):1599–605.

32 Dietz W, Baur L, Hall K, Puhl R, Taveras E, Uauy R, et al. Management of obesity: improvement of health-care training and systems for prevention and care. Lancet. 2015; 385(9986):2521–33.

33 Taveras EM, Marshall R, Kleinman KP, Gillman MW, Hacker K, Horan CM, et al. Comparative effectiveness of childhood obesity interventions in pediatric primary care: a cluster-randomized trial. JAMA Pediatr. 2015;169(6):535–42.

34 Trasande L. How much should we invest in preventing childhood obesity? Health Aff (Millwood). 2010; 29(3):372–8.

Key Points for 1% versus Fat Free Flavored Milk Analysis

Type Milk	Source	Calories	Fat	Sugar	Teaspoons (4 g sugar = 1 tsp)
TruMoo Nonfat chocolate milk	Small, rural independent school district	120 kcals	0 g total fat	18 g sugar	4.5
TruMoo 1% chocolate milk	TruMoo website	140 kcals	2.5 g total fat	18 g sugar	4.5
TruMoo Nonfat Strawberry milk	Small, rural independent school district	110 kcals	0 g total fat	18 g sugar	4.5
Strawberry milk, 1% fat	Food service management company	180 kcals	2.5 g total fat	30 g sugar	7.5

<u>Main issue:</u>

- Schools districts identified by food service management companies are serving flavored milk (strawberry milk) with 30 grams of sugar in one 8 oz serving, which is significantly higher than nonfat strawberry milk
    - According to food service management expert: best practice is 22 g of sugar in flavored milk, strawberry milk with 30 grams of sugar per serving is unusually high in sugar
- 1% chocolate milk with 18 g of sugar exists, are schools choosing the lowest-sugar option for flavored milk in schools?

<u>Academy previous position paper:</u>

- "ADA agrees with USDA that the proposed calorie maximum will drive schools to select flavored fat-free milk with the lowest sugar content" (Source: 2011 comment to Julie Brewer commenting on the proposed rules on nutrition standards in the NSLP and SBP)
- "The Academy supports the proposed requirement that only

low-fat and fat-free unflavored and flavored milk and milk products be sold in schools to reduce students' intake of saturated fat and calories…The proposed calorie maximum is also likely to drive schools to select flavored fat-free milk with the lowest sugar content" (Source: 2013 comment to Julie Brewer on NSLP and SBP: Nutrition Standards for all foods sold in school as required by the HHFKA of 2010)

Sugar recommendations:

- American Heart Association recommended preschoolers not have more than 3 tsp sugar a day and children/teens should consume less than 6 tsp of "added sugars" a day and drink no more than 8 oz of sugary beverages a week (Source: http://heartinsight.heart.org/Spring-2017/Kids-and-Sugar/)
- IOM in 2007 set recommendations for sugar at a maximum of 22 grams of total sugar/8 oz, containing 12 grams of inherent lactose and 10 g added sugar (Source: AAP Policy Statement: "Snack, sweetened beverages, added sugars, and school" (2015))
- AAP recommend limiting the consumption of added sugars to less than 10% of calories per day (https://www.aap.org/en-us/about-the-aap/aap-press-room/pages/DietaryGuidelines2015.aspx)

Scientific Research for support:

Johnson, R., Frary, C., & Wang, M. (2002). The nutritional consequences of flavored-milk consumption by school-aged children and adolescents in the United States. *Journal of the Academy of Nutrition and Dietetics, 102*(6): 853-856. Doi: http://dx.doi.org/10.1016/S0002-8223(02)90192-6

- Concern: flavored milk increases added sugar consumption and could lead to lower total milk consumption resulting from children developing a taste preference or dependence of flavored milk.
- 1st study to show the nutritional consequences of consuming

flavored milk in children and adolescents. What the study showed:

- Flavored milk intake was positively associated with energy adjusted calcium, phosphorous, and % energy from saturated fat, and negatively associated with energy-adjusted vitamin C and folate intakes in children aged 5-11 years
- Flavored milk was positively associated with energy-adjusted calcium, phosphorous, and fiber intake and negatively associated with energy-adjusted vitamin A intakes in children aged 12-17 years old
- The observation that flavored milk did not increase added sugars intake was in all likelihood the result of lower intakes of soft drinks and fruit drinks by children who consumed flavored milk
    - Would probably have seen increase in sugar content if all other components of children's diets were held constant/accounted for

• Applications:

- Flavored milk can play a role in changing recent trends in children's sugar-sweetened beverage consumption patterns that have a negative impact on their diet quality

Yon, B., Johnson, R., & Stickle, T. (2012). School children's consumption of lower-calorie flavored milk: a plate waste study. *Journal of the Academy of Nutrition and Dietetics, 112(1)*: 132-136. Doi: 10.1016lj.jada2011.09.011

• Data from the Third School Nutrition Dietary Assessment Study show that most elementary students (71%) choose flavored milk

• In anticipation of USDA changed guidelines for many dairy processors reformulated flavored milk to meet the Alliance for a Healthier Generation guidelines (</= 150 kcals/8 oz) Just more than ½ of flavored milks in schools during the

2009-2010 school year contained ^; however only 37% of school flavored milk was fat-free
    - Before reformulation: 170 kcals/8 oz, 1% milk fat, and up to 28 g total sugar
    - Reformulated milk: 150 kcals/8 oz and were either fat free of 1% milk fat, with total sugar content of 22-27 g
- Purpose of this study was to compare elementary school students' consumption of standard and reformulated lower-calorie flavored milk
- Hypothesis: Elementary students' consumption of lower-calorie flavored milk would be the same as consumption of higher calorie standard flavored milk (>150 kcals)
- Elementary schools drinking lower-calorie flavored milk were as likely to drink most of their milk in comparison with peers offered higher-fat or higher-sugar flavored milks
    - Students in reformulated group consumed an average of 4.92+/- 0.17 oz
        - 45% of students in reformulated group milk consumed most of their milk (>7 oz)
    - Students in standard group consumed an average of 5.88+/- 0.12 oz
        - 66% of students in standard flavored milk consumed most of their milk (>7 oz)
- Because there wasn't a large calorie difference between the reformulated and standard flavored milks, children may not have been able to detect the reductions in fat and sugar contents that could affect consumption
    - Work with toddlers suggests that reductions in the added fat and sugar may not affect consumptionàsuggests that dairy processors may have been successful in developing reformulated products that represented taste changes that are referred to by psychologists as unnoticeable difference where the product reformulation change is not perceived or

detected by the tasters

Bouhlal, S., Issanchou, S., & Nicklaus, S. (2011). The impact of salt, fat and sugar levels on toddler food intake. *British Journal of Nutrition, 105:* 645-653. doi:10.1017/S0007114510003752

- Sugar and fat are liked food features by children and the sweet and fat test preference in childhood can be explained by the pleasure or by the energy they provide, considering the energy needs while growing
- Age-related decline in sweet preference was documents: it is high in childhood and early adolescence and decreases in early adulthood
- The present study aims at evaluating the impact of salt, fat or sugar levels in common foods on children's intake, during a normal meal in a familiar environment. The general hypothesis is that salt, fat and sugar increase food palatability, which can potentially lead to an increase of food intake
- Concerning added sugar variations, they were tested in a fruit pure´e. It could be supposed that children would (iii) consume more of the sweeter versions of this food than of the unsweetened version.
- A total of seventy-four children (forty-two girls and thirty-two boys) participated in the study. Their average age was 30 (SE 4) months old (range 18–37 months)
- The children could eat as much as they wanted from the target foods by asking for additional servings if they wanted to, which was a common practice in each nursery
- Sugar level variations did not have an impact on fruit puree intake
- The present findings indicate that 2- to 3-year-old children's intake of a fruit puree was not affected by its added sugar content. Contrarily to our initial hypothesis, no increase in

intake with increasing added sugar level was observed.

- **sugar level did not elicit any difference in the intake of fruit puree.** That is to say, lowering the addition of fat or sugar while preparing children's foods, especially when the food is liked without any extra ingredients being added (such as starchy foods or fruit puree), may appear to be a useful way to reduce energy intake and to avoid the development of a habit of consuming foods rich in fat and sugar.

Yon, B. A., & Johnson, R. K. (2015). New School Meal Regulations and Consumption of Flavored Milk in Ten US Elementary Schools, 2010 and 2013. *Preventing Chronic Disease, 12,* E166. http://doi.org/10.5888/pcd12.150163

- Most (70%) elementary school students choose flavored milk over plain school at milk; children's flavored milk consumption is not associated with higher intakes of added sugars (source below)
- Study method: measured consumption of milk consumption by elementary-school children (grades 3-4) In a diverse sample of schools before and after implementation of USDA's updated meal regulations requirements flavored milk to be fat-free.
- Results: Flavored milk consumption did not change from 2010-2013; 52.2% of students in 2010 and 49.7% in 2013 consumed 7 oz or more of an 8 oz container
- Conclude: Updated regulations succeeded in lowering the amount of fat, added sugars, and calories in school milk but did not change overall milk consumption, thus improving children's diet quality

Noel, S., Ness, A., Northstone, K., Emmett, P., & Newby, P. (2013). Associations between flavored milk consumption and changes in weight and body consumption over time: differences among normal and overweight children. *European Journal of Clinical Nutrition, 67,* 295-200. Doi: 10.1038/ejcn.2012.123 (https://www.nature.com/ejcn/journal/v67/n3/full/ejcn2012123a.html)

- Subjects include 2270 children from Avon Longitudinal Study of Parents and Children; flavored milk consumption at age 10 years was assessed using dietary records; consumption was dichotomized as consumers and non-consumers; % BF measured w/ DXA
- Results: Overweight/obese children who consumed flavored milk has less favorable changes in BF compared with non-consumers; similar associations with body weight were observed
    - Adjusted mean %BF for overweight/obese girls who consumed flavored milk was greater at age 13 compared with 11 years
    - Mean %BF for overweight/obese boys were similar between consumers and non-consumers is at 13 years
- Conclusion: overweight/obese children who consumed flavored milk had less favorable changed in body composition over time. Although more research is needed, discouraging flavored milk consumption may be one beneficial strategy to address childhood obesity

<u>Sugar and the brain:</u> (Source: http://education.seattlepi.com/can-eating-foods-containing-sugar-affect-students-health-school-performance-2173.html

- Sugar and brain function; ingest sugar and get a sugar crash; body reacts to a flood of sugar with a flood of insulin. Too much insulin has been shown to correlate to lowered blood glucose, which causes people to have difficulty with attention and memory-both important components of learning
- Sugar and attention: high sugar consumption=high levels of cortisol releasedàmay not be able to pay attention in class or sit quietly; children who experience this frequently lose a substantial amount of learning time

•

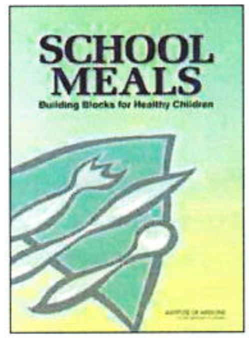
Lamb, M. M., Frederiksen, B., Seifert, J. A., Kroehl, M., Rewers, M., & Norris, J. M. (2015). Sugar intake is associated with progression from islet autoimmunity to type 1 diabetes: the Diabetes Autoimmunity Study in the Young. *Diabetologia*, *58*(9), 2027–2034. http://doi.org/10.1007/s00125-015-3657-x

- Sugar consumption via sugar-sweetened beverages can enhance the risk of developing type-1 diabetes
- The Diabetes Autoimmunity Study in the Young (DAISY) is a prospective study of two groups of young children at increased risk for developing type 1 diabetes. One group consists of unaffected first-degree relatives of patients with type 1 diabetes, identified and recruited generally between birth and age 4 years.
- A semi-quantitative food frequency questionnaire (FFQ)
- This prospective analysis of children at increased genetic risk for type 1 diabetes is a follow-up of a previous analysis in the DAISY cohort in which dietary glycaemic index was found to be associated with type 1 diabetes risk [7]. This follow-up analysis investigates in detail which nutrients and sugar-containing foods most strongly influence IA and type 1 diabetes risk. The results suggest that sugar intake may not affect the early stage of the type 1 diabetes disease process, prior to IA development. However, once the immune system has been activated by other genetic or environmental factors and the body has begun the autoimmune attack on the beta cells, the total amount of sugar that a child consumes may increase type 1 diabetes risk.

INSTITUTE OF MEDICINE

REPORT BRIEF • OCTOBER 2009

School Meals: Building Blocks for Healthy Children



Two national programs—the National School Lunch Program (NSLP) and the School Breakfast Program (SBP)—play key roles in supporting the nutrition and health of schoolchildren in the United States by providing nutritionally balanced, low-cost or free lunches each school day. In 2008, the NSLP provided lunch to more than 30.5 million children, and the SBP provided breakfast to 10.5 million children.

Currently, to receive federal reimbursement, school meals must meet regulations that were established in 1995 for Nutrition Standards and Meal Requirements. The complex set of regulations specifies amounts of nutrients that must be provided, meal planning approaches, and rules for the food that must be on the student's tray. Advances have been made in dietary guidance in the years since those regulations were established. To obtain assistance in updating the regulations, the U.S. Department of Agriculture (USDA) asked the Institute of Medicine (IOM) to provide recommendations to revise the standards and requirements for both the NSLP and the SBP.

To meet its task, an IOM committee reviewed and assessed the food and nutritional needs of school-aged children in the United States using the 2005 *Dietary Guidelines for Americans* set by the Department of Health and Human Services (HHS) and USDA, as well as the IOM's Dietary Reference Intakes (DRI). Furthermore, the committee reviewed the current regulations for the NSLP and SBP Nutrition Standards and Meal Requirements. The committee recommends numerous revisions and that emphasis be placed on revised Meal Requirements rather than on nutrients per se. The committee's recommended new approach clearly focuses on providing meals that are consistent with the *Dietary Guidelines for Americans*.

The committee's recommended new approach clearly focuses on providing meals that are consistent with the *Dietary Guidelines for Americans*.

RECOMMENDED MEAL REQUIREMENTS

The committee makes recommendations for Meal Requirements, which encompass two types of standards: 1) standards for menu planning and 2) standards for meals as selected by the student (in contrast to those that are simply offered to students). Standards are needed for meals as selected because, by law, all high schools are required to allow students to decline a specified number of food items (to reduce waste), and other schools may choose to do so (a majority of them do so).

In order to align school meals with the *Dietary Guidelines for Americans* and improve the healthfulness of school meals, the committee recommends that the Food and Nutrition Service of the USDA adopt standards for menu planning that:

- increase the amount and variety of fruits, vegetables, and whole grains;
- set a minimum and maximum level of calories; and
- increase the focus on reducing the amounts of saturated fat and sodium provided.

The committee recommends a single approach to menu planning—one that includes a meal pattern (which specifies the types and amounts of food in the meal) plus specifications for minimum and maximum calorie levels, maximum saturated fat content, and maximum sodium content. Some of the recommended changes are described in Table 1. Because the meal pattern alone cannot ensure appropriate amounts of calories, saturated fat, and sodium, the committee set specifications for those three dietary components. The combination results in meals that are nutrient-rich but moderate in calories.

The committee recommends a single approach to menu planning—one that includes a meal pattern plus specifications for minimum and maximum calorie levels, maximum saturated fat content, and maximum sodium content.

TABLE 1: KEY RECOMMENDED CHANGES IN SCHOOL LUNCH REQUIREMENTS

Type of Specification	Current Requirements	Recommendations
Fruits	Considered together as a fruit and vegetable group. No specifications for the type of vegetable	Required daily amount increased
Vegetables		Two servings required daily, amount increased. Must include dark green, bright orange, legumes, starchy, and other vegetables each week
Grains/ Breads	No requirement for whole grains	At least half must be whole grain rich
Milk	Whole, reduced-fat, low-fat, fat-free milks (plain or flavored)	Fat-free (plain or flavored) and plain low-fat milk only
Calories	Must meet minimum level	Must be within minimum and maximum level
Sodium	None (decreased level recommended)	Gradually but markedly decrease sodium to the specified level by 2020

The committee developed two options for the standards for meals as selected by the student. The options differ in the number of food items that may be declined, but both of the options include a new specification: that the student must select a fruit at breakfast and either a fruit or a vegetable at lunch for the meal to be reimbursable.

NUTRIENT TARGETS

The current Nutrition Standards include eight specific requirements covering calories, fat, protein, and several vitamins and minerals. To achieve consistency with *Dietary Guidelines* and the DRIs, however, the committee found it necessary to increase the number of nutrients considered and, using a new concept, to replace Nutrition Standards with Nutrient Targets. The committee developed the Nutrient Targets (which encompass 24 nutrients and other dietary components) as guidelines to determine the amount and type of food groups to be offered to students. These are not intended to be used as specific requirements for menu planning or to monitor menus, as is the case with the current Nutrition Standards.

The committee stresses the importance of reducing the sodium content of foods and, therefore, recommends that USDA work cooperatively with HHS, the food industry, professional organizations, state agencies, advocacy groups, and parents to develop strategies and incentives to achieve such a task. The committee recognizes that there are barriers to reducing the sodium content of meals to the levels that are recommended without having adverse effects on student acceptance and participation, safety, practicality, and cost. In recognition of the barriers, the committee suggests that implementation be fully achieved by 2020; and it proposes that intermediate targets be set at two-year intervals and periodically evaluated to promote step-wise reductions in sodium content over the decade beginning in 2010.

RECOMMENDATIONS FOR IMPLEMENTATION AND MONITORING

The manner in which Meal Requirements are implemented and monitored will determine whether students participate in the NSLP and SBP and consume the food that is offered. Important implementation strategies to promote change and increase student participation in the program include engaging the school community; involving students, parents, and the community; providing nutrition education; training and mentoring food service workers; and providing technical assistance. Industry involvement will be essential to the implementation process, including the introduction of appealing foods that are lower in sodium and saturated fat and those that have a higher ratio of whole grain to refined grain. In addition, new monitoring procedures will guide implementation efforts.

Recommended support from the Food and Nutrition Service includes:

- Technical assistance for developing and continuously improving menus, ordering appropriate foods (including the writing of specifications), and controlling costs while maintaining quality.
- New procedures for monitoring the quality of school meals that (1) focus on meeting relevant *Dietary Guidelines*, and (2) provide information for continuous quality improvement and for mentoring food service workers to assist in performance improvement.

CONCLUSION

Since the NSLP's inception, more than 219 billion lunches have been served. Implementation of the committee's recommendations will lead to healthier meals in the NSLP and the SBP—meals that are much more consistent with *Dietary Guidelines for Americans*. With comprehensive technical assistance from USDA and the support and involvement of state agencies, professional organizations, the food industry, child advocacy groups, schools, parents, and students, these school meals will appeal to students and contribute to their health and well being.

With comprehensive technical assistance from USDA and the support and involvement of state agencies, professional organizations, the food industry, child advocacy groups, schools, parents, and students, these school meals will appeal to students and contribute to their health and well being.

FOR MORE INFORMATION . . .

Copies of *School Meals: Building Blocks for Healthy Children* are available from the National Academies Press, 500 Fifth Street, N.W., Lockbox 285, Washington, DC 20055; (800) 624-6242 or (202) 334-3313 (in the Washington metropolitan area); Internet, www.nap.edu. The full text of this report is available at www.nap.edu.

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COMMITTEE ON NUTRITION STANDARDS FOR NATIONAL SCHOOL LUNCH AND BREAKFAST PROGRAMS

VIRGINIA A. STALLINGS, (Chair), The Children's Hospital of Philadelphia, University of Pennsylvania; **KAREN WEBER CULLEN**, Children's Nutrition Research Center, Baylor College of Medicine, Houston,TX; **ROSEMARY DEDERICHS**, Minneapolis Public Schools, Special School District No. 1, MN; **MARY KAY FOX**, Mathematica Policy Research, Inc., Cambridge, MA; **LISA HARNACK**, Division of Epidemiology and Community Health, University of Minnesota, MN; **GAIL HARRISON**, School of Public Health, Center for Health Policy Research, University of California, Los Angeles; **MARY ARLINDA HILL**, Jackson Public Schools, MS; **HELEN H. JENSEN**, Department of Economics, Iowa State University, Ames; **RONALD E. KLEINMAN**, Massachusetts General Hospital for Children, Harvard Medical School, Boston, MA; **GEORGE P. McCABE**, College of Science, Purdue University, West Lafayette, IN; **SUZANNE P. MURPHY**, Cancer Research Center of Hawaii, University of Hawaii, Honolulu; **ANGELA ODOMS-YOUNG**, Department of Kinesiology and Nutrition, University of Illinois at Chicago, IL; **YEONHWA PARK**, Department of Food Science, University of Massachusetts, Amherst; **MARY JO TUCKWELL**, in-TEAM Associates, Ashland, WI

STUDY STAFF

CHRISTINE TAYLOR, Study Director; **SHEILA MOATS**, Associate Program Officer; **JULIA HOGLUND**, Research Associate; **HEATHER BREINER**, Program Associate; **CAROL WEST SUITOR**, Consultant Subject Matter Expert and Writer; **ANTON BANDY**, Financial Officer; **GERALDINE KENNEDO**, Administrative Assistant, Food and Nutrition Board; **LINDA D. MEYERS**, Director, Food and Nutrition Board

TABLE S-1 Recommended *as Offered* Meal Standards

	Breakfast			Lunch		
	Grades K–5	Grades 6–8	Grades 9–12	Grades K–5	Grades 6–8	Grades 9–12
Meal Pattern	Amount of Foods[a] Per Week					
Fruits (cups)[b]	5	5	5	2.5	2.5	5
Vegetables (cups)[b]	0	0	0	3.75	3.75	5
Dark green	0	0	0	0.5[c]	0.5[c]	0.5[c]
Orange	0	0	0	0.5[c]	0.5[c]	0.5[c]
Legumes	0	0	0	0.5[c]	0.5[c]	0.5[c]
Starchy	0	0	0	1	1	1
Other	0	0	0	1.25[c]	1.25[c]	2.5[c]
Grains, at least half of which must be whole grain-rich[d] (oz eq)	7–10	8–10	9–10	9–10	9–10	12–13
Meats, beans, cheese, yogurt (oz eq)	5	5	7–10	8–10	9–10	10–12
Fat-free milk (plain or flavored) or low-fat milk (1% milk fat or less) (cups)	5	5	5	5	5	5
Other Specifications	Other Specifications: Daily Amount Based on the Average for a 5-Day Week					
Min-max calories (kcal)[e,f]	350–500	400–550	450–600	550–650	600–700	750–850
Saturated fat (% of total calories)[g]	< 10	< 10	< 10	< 10	< 10	< 10
Sodium (mg)	[≤ 430]	[≤ 470]	[≤ 500]	[≤ 640]	[≤ 710]	[≤ 740]
	Sodium targets are to be reached by the year 2020.[h]					
trans fat	Nutrition label must specify zero grams of *trans* fat per serving.[i]					

NOTES: K = kindergarten; kcal = calories; max = maximum; mg = milligrams; min = minimum; oz eq = ounce equivalent. Although the recommended weekly meal intake patterns do not specify amounts of unsaturated oils, their use is to be encouraged within calorie limits.

[a]Food items included in each group and subgroup and amount equivalents. Appendix Table H-1 gives a listing of foods by food group and subgroup. Minimum daily requirements apply: 1/5 of the weekly requirement for fruits, total vegetables, and milk and at least 1 oz equivalent each of grains and meat or meat alternate (2 oz of each for grades 9–12 lunch).

[b]One cup of fruits and vegetables usually provides two servings; ¼ cup of dried fruit counts as ½ cup of fruit; 1 cup of leafy greens counts as ½ cup of vegetables. No more than half of the fruit offerings may be in the form of juice.

[c]Larger amounts of these vegetables may be served.

[d]Based on at least half of the grain content as whole grain. Aiming for a higher proportion of whole grain-rich foods is encouraged. See Box 7-1 for Temporary Criterion for Whole-Grain Rich Foods. Also note that in Chapter 10 the committee recommends that the Food Buying Guide serving sizes be updated to be consistent with MyPyramid Equivalent serving sizes.

[e]The average daily amount for a 5-day school week is not to be less than the minimum or exceed the maximum.

[f]Discretionary sources of calories (for example, solid fats and added sugars) may be added to the meal pattern if within the specifications for calories, saturated fat, *trans* fat, and sodium.

[g]The average daily amount for a 5-day school week is not to exceed the maximum.

[h]To ensure that action is taken to reduce the sodium content of school meals over the 10-year period in a manner that maintains student participation rates, the committee suggests the setting of intermediate targets for each 2-year interval. (See the section "Achieving Long-Term Goals" in Chapter 10.)

[i]Because the nutrition facts panel is not required for foods with Child Nutrition labeling, the committee suggests that only products with 0 grams of *trans* fat per serving be eligible for consideration for such labeling.

CHILDREN AND THE IMPORTANCE OF MAINTAINING A HEALTHY WEIGHT

Good nutrition and physical activity are particularly important for infants, toddlers and young children who need an adequate intake of key nutrients while their brains and bodies are rapidly developing. The foundations for lifelong, healthy eating and physical activity begin in these formative years. A child's health is even impacted by the mother's underlying health before and during pregnancy — where a mother's obesity and diabetes puts the child at increased risk for a range of health concerns.

- Children who are overweight or obese are more likely to be obese as adults. Being overweight or obese can put children at a higher risk for health problems such as heart disease, hypertension, type 2 diabetes, stroke, cancer, asthma and osteoarthritis — during childhood and as they age.[50, 51]
- Preventing obesity early can impact a child's lifetime trajectory. A study of more than 7,700 children found that a third of the children who were overweight in kindergarten were obese by eighth grade. When the children entered kindergarten, 12.4 percent were obese and another 14.9 percent were overweight; in eighth grade, 20.8 percent were obese and 17 percent were overweight. Overweight 5-year-olds were more than four times as likely as healthy-weight children to become obese.[52]

Obesity is associated with higher healthcare needs and costs among children:

- Overweight and obesity in childhood is associated with $14.1 billion in additional prescription drug, emergency room and outpatient visit healthcare costs annually.[53] An obese 10-year-old child who continues to gain weight throughout adulthood has lifetime medical costs that are $19,000 higher compared to a healthy-weight 10-year-old who maintains a normal weight throughout life.[54]
  - A child who is obese for two consecutive years has a $194 higher outpatient visit expenditure, a $114 higher prescription drug expenditure and a $12 higher emergency room expenditure compared to a normal/underweight child during the same two years, based on a Medical Expenditure Panel Survey (2002-2005).[55]
- The average total annual health cost for a child treated for obesity under private insurance is $3,743, while the average health cost for all children covered by private insurance is $1,108.[56]
- Hospitalizations of children and youths with a diagnosis of obesity nearly doubled between 1999 and 2005, while total costs for children and youths with obesity-related hospitalizations increased from $125.9 million in 2001 to $237.6 million in 2005 (in 2005 dollars).[57]

Focusing on nutrition and physical activity early can help improve a child's future health — particularly among children from low-income families:

- Children who grow up in low-income families and neighborhoods are at higher risk for obesity and related health problems.[58, 59]
  - More than 15 million children (20.9 percent) experience food insecurity annually — where their family has limited access to adequate food and nutrition due to cost, proximity and/or other reasons.[60, 61]
  - Nearly half of infants and toddlers under 3-years-old live in low-income families; 24 percent live in poverty; and 6.6 percent of the U.S. population lives in deep poverty.[62, 63] (Low-income is defined as two times the federal poverty level (FPL); poverty is below FPL; deep poverty is earning less than $6,000 per year or raising a child on less than $7,600 per year.)
  - Seventy percent of Black, 66 percent of Native American, 64 percent of Latino and 34 percent of White children under the age of three live in low-income families.

OBESITY AND ADVERSE CHILDHOOD EXPERIENCES (ACES) AND TOXIC STRESS

Stress and trauma in childhood can harm and alter a child's body and brain. Adverse childhood experiences, adverse family experiences and toxic stress can dramatically increase a child's likelihood of becoming obese and for developing many obesity-related illnesses.

Adverse Family Experiences

- Around one-third (30.5 percent) of children experienced two or more adverse family experiences, including 1) divorce or separation; 2) death; 3) incarceration of a parent or guardian; 4) living with anyone who was mentally ill, suicidal or severely depressed; 5) living with anyone who had an alcohol or drug problem; 6) witnessing any violence in the household; 7) being the victim of violence or witnessing violence in the neighborhood; 8) suffering racial discrimination; and 9) having a caregiver who often found it hard to get by on the family's income. [64, 65]
- Youth ages 10 to 17 who have experienced two or more adverse family experiences have an 80 percent higher chance of obesity than children who do not experience such events, according to an analysis of the 2011–2012 National Survey of Children's Health (NSCH).[66] The strongest association between adverse family experiences and obesity was among White children, and there was no reported association among Black children.

Toxic Stress

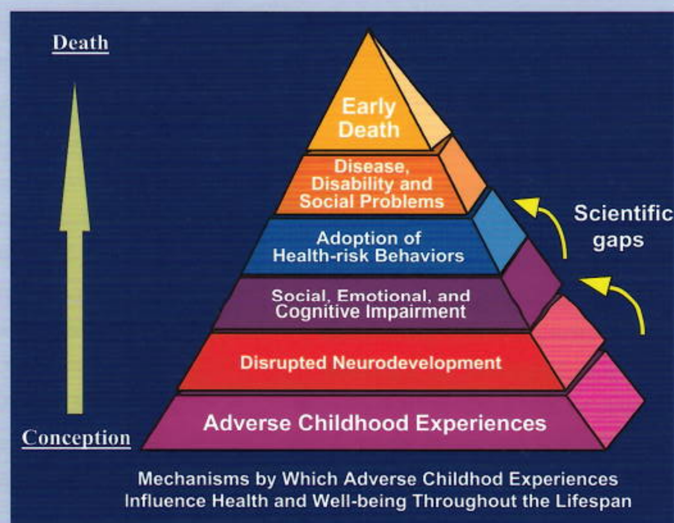
Toxic stress occurs when children experience not just one traumatic event but rather are exposed to repeated and ongoing traumas, such as physical, sexual or emotional abuse, chronic neglect, caregiver substance abuse or mental illness, repeated exposure to violence in the home or in their neighborhood and/or the accumulated burden and stress of family economic hardship.[67] More than half of U.S. public school students live in poverty, which can contribute to toxic stress as well as to obesity.[68, 69]

Adverse Childhood Experiences

More than half of children experience an adverse event during childhood — and many experience multiple co-occurring adverse events.[70, 71] The most commonly reported ACEs were physical abuse (28.3 percent), substance abuse in the household (26.9 percent), sexual abuse (24.7 percent for girls and 16 percent for boys) and parent divorce or separation (23.3 percent).[72] More than one-quarter (27 percent) of children experience at least two ACEs, 14 percent experience three and 7 percent experience four or more. The more ACEs experienced, the higher likelihood for increased negative outcomes. The prevalence of ACEs increases with a child's age, except for economic hardship, which is reported relatively equally for children of all ages.

Children with four or more ACEs had a 220 percent greater risk of heart disease than children experiencing no ACEs. They had a 240 percent greater risk of stroke, and 160 percent greater risk of diabetes. An ACE score of 6 or more could lower life expectancy by two decades.[73] Adults who were abused as children have higher incidences of heart disease, chronic lung disease, cancer and liver disease; and are more likely to be smokers or obese.[74,75]

Research also shows that support from caring adults and protective systems can help buttress or reduce the negative effects that toxic stress, ACEs and other adverse family experiences can have on a child. Programs and services that help give parents and caregivers additional resources, skills and support can help them in turn provide safe, stable and nurturing environments for their children.[76]



Source: Centers for Disease Control and Prevention

ACE-Related Odds of Having a Physical Helath Condition

Health Condition	0 ACEs	1 ACEs	2 ACEs	3 ACEs	4+ ACEs
Arthritis	100%	130%	145%	155%	236%
Asthma	100%	115%	118%	160%	231%
Cancer	100%	112%	101%	111%	157%
COPD	100%	120%	161%	220%	399%
Diabetes	100%	128%	132%	115%	201%
Heart Attack	100%	148%	144%	287%	232%
HeartDisease	100%	123%	149%	250%	285%
Kidney Disease	100%	83%	164%	179%	263%
Stroke	100%	114%	117%	180%	281%
Vision	100%	167%	181%	199%	354%

Source: Iowa Aces 360